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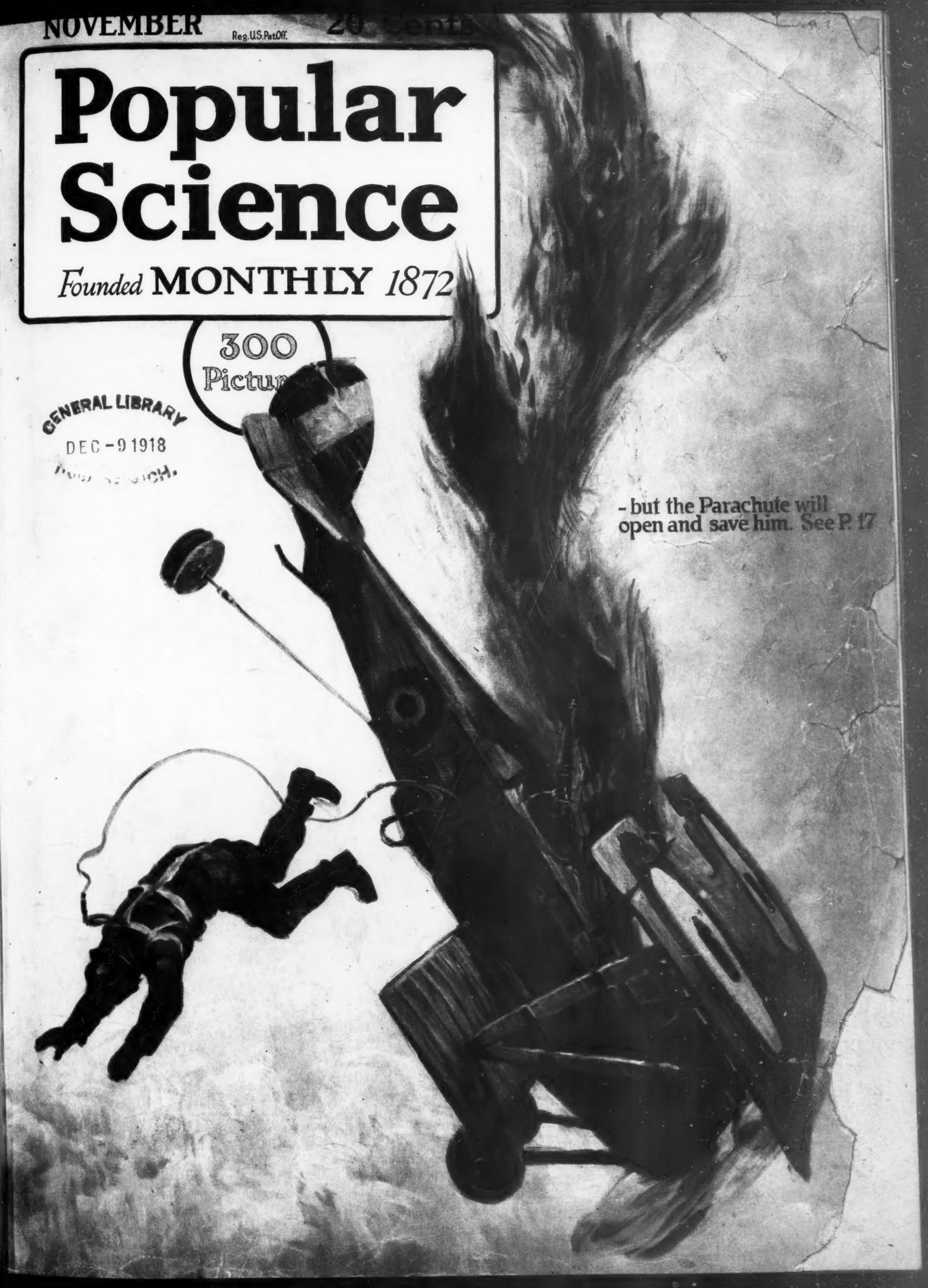

- but the Parachute will open and save him. See P. 17

. . . and at big hotels and clubs, East and West

A fact:

Sales reports from 8 leading cities—just as received at our main office during the last week in August:

ARMY and NAVY CLUB, Washington, D. C.:
"Fatima sells biggest—irrespective of price"

BELLEVUE-STRATFORD, Philadelphia:
"Fatima outsells all other cigarettes, except two 25-cent brands"

CONGRESS HOTEL, Chicago:
"Fatima is one of the leading sellers among the better brands"

HOTEL ASTOR, N. Y. City:
"We sell more Fatimas than any other cigarette"

HOTEL GIBSON, Cincinnati:
"Fatima leads all other brands in sales"

HOTEL SINTON, Cincinnati:
"More Fatimas are sold than any other cigarette"

HOTEL WILLARD, Washington, D. C.:
"Fatima is biggest-selling cigarette"

MARSHALL FIELD'S GENTLEMEN'S GRILL, Chicago:
"Fatima is as big if not a bigger seller than any of the other high-class brands"

OFFICERS' CLUB, West Point:
"More Fatimas smoked than any other cigarette"

THE PONCHARTRAIN, Detroit:
"Fatima is the second best-selling brand"

RACQUET CLUB, St. Louis:
"Fatima is largest seller"

THE SHOREHAM, Washington, D. C.:
"With one exception, Fatima is best seller"

UNION CLUB, Cleveland:
"Fatima is one of the largest sellers"

YALE CLUB, New York City:
"Fatima continues to be one of the three best sellers"

FATIMA

A Sensible Cigarette

And Fatima gives full, honest value—instead of "showy" looks. It is for every smoker who wants a cigarette that never "talks back," even if a man should smoke more often than usual.

Liggett & Myers Tobacco Co.

Popular Science Monthly

Waldemar Kaempffert, *Editor*

November, 1918: Vol. 93, No. 5
Twenty Cents: Two Dollars a Year

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at 225 West 39th Street

"Stepping Over" at 10,000 Feet

Will the Parachute Become a Real Life-Preserver of the Air?

"AT a height of ten thousand feet his machine burst into flames. His body was picked up, charred beyond recognition."

How often have you not read the sentence in a press despatch? You sickened at the thought of a brave man in the sky, either unbelting himself, as Lufbery did, and jumping to a swift, merciful death, or of being burnt alive in a roaring furnace, fanned by a cyclonically swift fall. Can nothing be done to give him at least a fighting chance? Is there no life-preserver of the air?

The parachute at once suggests itself. But parachutes have been used successfully only by professional aeronauts who make farmers gasp at county fairs, or by artillery officers who man the captive observation balloons at the front. In all the long history of peace-time ballooning there is no record of a man having saved himself by jumping overboard with a great umbrella. Even the crazed crews of Zeppelins have leaped to death from their flaming ships: an efficient General Staff, which was supposed to foresee everything, had not considered it worth while to provide parachutes.

Difficulty of Placing the Parachute

Although the parachute had not been adopted as part of a balloon's or an airship's regular equipment, the possibility of using it as a life-preserver was seriously considered as soon as an airplane had been invented that would actually fly. Both in Europe and in America, brave pioneers demonstrated their belief in the parachute by leaping with it from their airplanes. Pégoud, in France—the same Pégoud who first looped-the-loop in a flying-machine—was the first who experimented with a parachute in a single-seated machine.

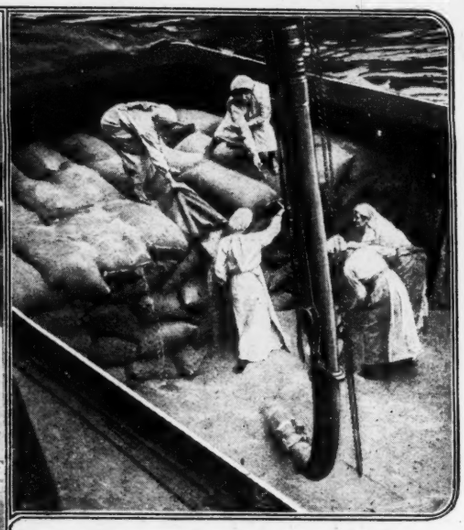
What are the objections to the parachute? The chief objection is the difficulty of placing it on an airplane so that it will be more accessible than a life-belt on shipboard, so that it will open within a second or two after the pilot has leaped, and so that it will not foul the tail or wings at the critical moment.

So much progress has been made that a parachute of some kind will soon form part of the standard equipment of every airplane. The war has certainly done much to revive interest in the subject, partly because aviators fly at greater heights than were attained before the war, so that the parachute has a better chance to open, and partly because parachutes have been greatly improved.

Captain Sarret's Leap

Recently Captain Sarret, of the French army, leaped to safety from a height of 2,500 feet. He crawled out of his seat, saw to it that the parachute was properly adjusted, and jumped. The greater the distance, the better are the chances of coming down in safety.

The "Guardian Angel" parachute is an invention of Calthorp, an Englishman. It was recently tested successfully by Captain Sarret. The parachute is contained in a box fastened to the machine. As the aviator steps overboard this box is jerked away. The machine pictured has two such boxes for two parachutes. One man has jumped; his parachute box is shown streaming behind the machine, attached by its rope. After a man has jerked out the box, the pull of his body draws out the parachute from the box



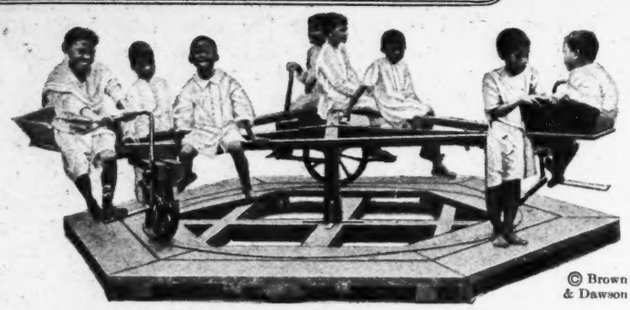
They Shovel the Grain We Saved

SOME of the wheat we are saving under Mr. Hoover's direction goes right up the Thames to London and is milled there. Women do the unloading. They rip open the end of a sack and empty out the contents, which are conveyed to the mill by suction through the pipe in the foreground. The device adapts what would otherwise be the heaviest sort of work to a vigorous woman's strength.

These workers are the first women stevedores.

The Largest Book in the World

THE largest book in the world—fifteen feet high, eight feet wide, and three feet thick—stands in the public square in Ottawa, Canada. It was made and bound by the Canadian government printing bureau at Ottawa. During the Victory Loan campaign the question of the hour in Ottawa was, "Is your name written there?" The book contains the names of all contributors. The book is bound in some composition material which remains in good condition despite the fact that it is exposed to the weather.



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These Youngsters Are Blind Boys on a Joy Ride

A LITTLE engineering ingenuity has made dozens of blind and deaf children in Manila happier.

Deaf and blind children are sometimes hard to amuse. A man who fashions some plaything that can make perpetual darkness and silence a little easier to endure adds a jewel to his heavenly crown.

The merry-go-round that has been placed at the disposal of the children in the Deaf and Blind School in Manila is simple enough for the boys and girls to operate.

The whirling structure comprises a triangular framework of wood scantlings pivoted on a stout wood post in the center. At each point of the triangle is a seat and a wheel Legs and arms supply the motive power.

Dropping Truth from the Skies

DESPATCHES from France have told of the use by the Allied and American armies of small balloons for scattering propaganda literature behind the German lines.

Here (below) is the working model of a balloon invented for that purpose, in the hands of its inventor, Lee A. Collins of Louisville, Ky., who turned it over to the Naval Consulting Board. He believes it is the model now being used.

The bag is of waterproof silk, about three feet high when inflated with hydrogen. It will carry twenty pounds of tracts.

Another Kind of Camouflage

IN war work, as in nature, there are two kinds of camouflage coloration; one designed to make the camouflaged object harder to distinguish from its surroundings, the other to make it even more conspicuous than it otherwise would be. The latter, however, in war work is restricted to objects used for recruiting purposes. The ocean-going freighters at anchor in the North River, off Manhattan Island, or in any other large harbor, are examples of the first kind. The picture below is an example of the second, undergoing its camouflage painting at the hands of members of the Camouflage Corps of the National League for Women's Service.

The tank stands in front of the New York Public Library. Its object is to aid recruiting for the tank service. The young women in overalls are making its surface a crazy-quilt of the most violent colors imaginable.

The effigy topping the tank's turret, which seems to be a cross between a puma and a Teddy bear, was put there to make it harder —to overlook the tank.

© Underwood & Underwood

Making a Wall Out of an Old Sidewalk

IF you have an old flagstone pavement that you don't know what to do with, the picture above may show you how to put it to a useful purpose. A property-owner laid concrete alongside of his land, and a year or so later the strip of land was graded to make room for a street. Instead of carting the sidewalk away, this owner simply turned it on end, thereby making it serve as a retaining wall for the higher portion of his land.

How to Eat the Mango

ONCE a traveler in the American tropics scorned to use the mango fork his host proffered, and ate his mango with his fingers. When he finished, his wife whispered dryly in his ear: "Now you'd better excuse yourself and go and take a bath."

Mangoes have a tough skin, and a large central pit or seed, in which there is a small aperture at the base. Between is a quantity of dripping pulp of exquisite flavor.

The fork has a long, sharp middle tine, which you thrust into the aperture of the pit. The shorter tines pierce the pulp and hold the fruit firmly.

The picture below shows a Tehuana belle of the Zapotec Indians of Tehuantepec, Mexico, demonstrating the mango fork.

Not to Be Sneezed At

HATZIE!—Hatzie!—Hatzie! Three violent explosions, then the sufferer from hay-fever awaits the next explosion.

Now, quick! This is the moment for applying the soothing treatment. The sufferer draws from his pocket a small object of curious form. Its lower part is shaped like a minute metal box; the top has two humps like the back of a camel. He opens the box, pours into it a few drops from a little bottle, carefully closes box and bottle, inserts the two humps of the top into his nostrils, and sniffs.

The appliance is a new invention superior to the old-fashioned smelling bottle, since it makes it possible to treat the inflamed membranes of both sides of the nose simultaneously.

Wash-Day Behind the American Lines in France

IT looks like the stockyards, with human stock in pens with white cloth walls. But it is only part of one day's wash of some British and American troops in France, hung out by Frenchwomen who do their laundering.

The laundry work made necessary by a modern army in the field is an appalling contract. So far as possible, it is done for the soldiers in this way. There are several reasons. The soldiers are now enabled, and required, to wash such pairs of their woolen socks as outlast the first wearing. This is a preventive measure against "trench foot." But on duty they seldom have opportunity to wash any other garments, and if they had they would probably shrink them beyond further usefulness.

The army authorities do their best to provide every man with a change of clean clothing at reasonably frequent intervals. For one thing, it somewhat discourages that unspeakable pest, the "cootie," which it took a war like this to bring into good society.

Fighting Young Chicken-Hawks

ALTHOUGH these young chicken-hawks would never take a beauty prize, they are nevertheless entitled to a bit of admiration for the spirit they show. They have just emerged from their respective shells. Still unaccustomed to the intrusion of the camera-man, they resent it, as some human beings do. Although they have not learned how to stand on their legs or manipulate their unfeathered wings, they are prepared to use their beaks, and their eyes can shoot daggers of defiance.

One egg in the nest did not hatch out, and the mother hawk has abandoned it, evidently urged to seek food by the hunger of the noisy triplets.

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Uncle Sam—Canny Buyer

When he goes shopping for his army and navy, he doesn't take any chances

By A. M. Jungmann

Uncle Sam does not take anything for granted when he buys supplies for his fighting nephews. Everything, from shoes to motor-truck tires, is carefully tested by experts before it is accepted

SUPPOSE you were intrusted with the spending of the millions of dollars a day that Uncle Sam is using for the purchase of war materials. How would you go about it? Would you enter upon the task with the same careless gambling spirit that carries you through your own purchases? Would you buy certain things from one source because you thought they were cheap, and other things from another source because you believed the men who sold them to you were honest?

That is generally the way you go about buying your own necessities; but it is not the manner of Uncle Sam's purchasing. He does not guess about the quality of materials he purchases for war use: he knows.

How, you ask, can any one know what qualities an article possesses until he has given it a trial? That is exactly what Uncle Sam does. He tries things out before he buys them.

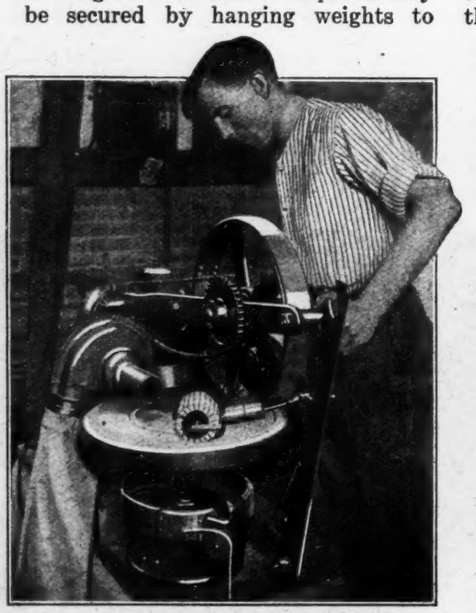
The Walking Machine

On the outskirts of the city of Washington, where the wheels of war are turning night and day, is a group of buildings known as the Bureau of Standards. Here scientists devote their time to testing war materials. Before Uncle Sam buys shoe leather, he must know how long the soles of the army shoes will wear.

Mr. Wormeley, of the Bureau of Standards, has devised a machine that actually walks forty miles on the soles Uncle Sam is considering. If, at the end of that forty miles, the leather does not seem satisfactory, it is discarded, and the machine starts on another forty-mile tramp with another set of leather samples. It tests twelve pieces of leather at one time.

This tireless walking machine consists of a wheel measuring fifteen inches in diameter, which carries on its face twelve pieces of leather that are to be tested. The wheel makes thirty revolutions every minute, traveling around a horizontal axis with its bearings in two parallel metal bars, which are pivoted at one end.

The weight of the bars, and any additional weight that may be attached to their free end, is carried by the wheel. The wheel, with its leather samples, rests on a horizontal carborundum-surfaced disk sixteen inches in diameter. The disk rotates around a vertical axis. A provision for obtaining resistance to rotation is made by means of a brake wheel and strap attached to the axis of the disk; and the degree of resistance required may be secured by hanging weights to the brake strap. The machine is electrically operated. The wheel bearing the leather samples is driven by a chain, and in turn drives the horizontal disk. In this manner the pieces of leather are brought down on the revolving disk in such a way that the action on the leather is uncannily like that of the human foot in walking. They get the same driving pressure that a man gives his shoe soles when he steps, and the rotation of the carborundum disk, as the leather on the wheel comes into contact with it, gives identically the same abrasive action that walking gives to shoe soles. In lifting his weight from one foot to the other a man gives the foot a slight circular motion, which abrades his shoe sole.



A machine that walks forty miles in less than twenty-two hours: used to test the wearing quality of shoe leather

In walking forty miles in something less than twenty-two hours and a quarter, the machine naturally wears out considerable shoe leather. Therefore, unless some means were provided to care for the fine particles of leather that are worn from the test pieces, the surface of the disk would soon be covered with a leather dust. A circular brush sweeps the particles from the disk, and they are taken away by a vacuum device constructed on the principle of the familiar vacuum cleaner.

Making Sure of the Army Truck

What shoes are to our marching men, tires are to our army trucks. It has been found necessary to make definite specifications as to the solid rubber tires used on army trucks.

The Bureau of Standards is now engaged in testing pneumatic tires for use on army trucks. The tires are tested for their wearing qualities, and are subjected to treatment similar to that given sole leather; that is to say, they are artificially put to the same strain and wear they would experience if they were in service on a truck. This investigation will result in Uncle Sam drawing up

specifications for his pneumatic tires.

Speaking of automobile tires leads us to consider lubricating oils. Here is something else for which Uncle Sam is working to establish a standard. When every nerve of the country is strained to bring about conditions conducive to victory, we cannot afford to take chances on lubricating oils being imperfect and causing damage to necessary and expensive machinery.

The Government is endeavoring to establish certain standards in lubricating oils so that specifications can be drawn up and the oils purchased accordingly. This work is in the hands of Mr. Winslow H. Herschel, and he is endeavoring to establish a standard of demulsibility. That is to say, a lubricating oil of a given grade must not take more than a specified time to separate from water after having been stirred to an emulsion.

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Everybody knows how important shoes are to a soldier. The Government employs a large number of men to inspect sole leather to be used for the army

Lubricating oils used for high-speed engines and steam turbines are likely to receive water from leaky stuffing boxes or cooling coils, and thus form an emulsion. In a circulatory system it is necessary to filter the oil; therefore an emulsifying oil cannot be used satisfactorily, because the formation of an emulsion may clog the filter, shut off the oil supply, and damage the bearings.

The difference that is found in lubricating oils is astonishing. In the Government laboratory I have seen an emulsion of lubricating oil and water demulsify—resolve itself into oil and water—in a couple of minutes; and I have seen glass containers holding oil and water that have remained in a state of emulsion for months.

Demulsibility Test for Oils

The test for demulsibility of lubricating oils is very simple. One part of water to two parts of oil are placed in a cylinder, and stirred by means of an electrically operated paddle revolving at the rate of fifteen hundred revolutions a minute. The emulsion that is formed by this means is then allowed to stand at the same temperature, and readings are taken from a scale etched on the glass container as the oil separates.

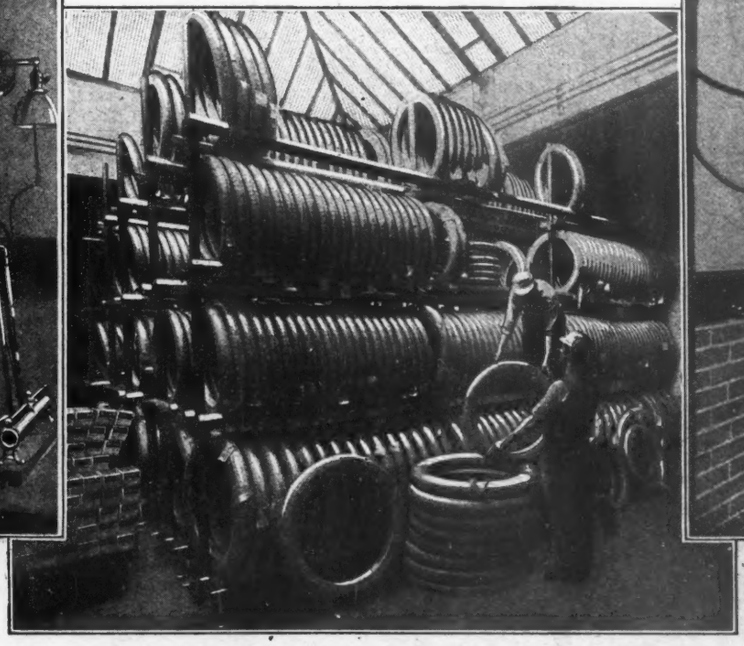
The freedom with which an oil will run depends upon its viscosity. Naturally, a light oil runs more freely than does a heavy one. All oils are affected by temperature changes. Therefore Uncle Sam tests oils not only for their demulsibility, but for their viscosity as well.

A Standard for Manufacturers

This is done by the use of an instrument called a viscosimeter. The length of time it takes an oil to travel through a tube of a given diameter is compared to the time it takes water to pass through the same tube. The time of the passage of water is used as the standard of measurement. The more viscous the oil, the longer time it will take to pass through the tube. The instrument can also regulate the temperature of the oil.

As a result of the experiments conducted to establish the viscosity of various oils, the Bureau of Standards has developed standard dimensions for viscosimeters. Standard instruments will do much toward bringing about standards in oils. It is the ultimate object of the bureau to make it possible for manufacturers to describe their oils in terms of actual measurements.

This machine tests the endurance of rubber tires for army trucks, subjecting them to the same wear and tear they would get in the service

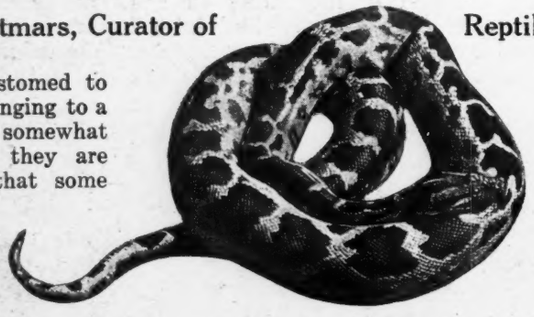


Uncle Sam must be sure of his army truck tires, so he has them made according to his own specifications. These tires which the men are piling up in racks are ready for delivery

Testing the quality of lubricating oils. A satisfactory oil will separate from water within a few minutes after being stirred to an emulsion

Breaking a Snake's Hunger Strike

By Raymond L. Ditmars, Curator of Reptiles in New York Zoological Park



BECAUSE we are accustomed to think of snakes as belonging to a low order of life, it is somewhat astonishing to learn that they are creatures of moods and that some members display an almost human temperament.

Snakes in captivity, especially those from India and other tropical countries, mourn their native haunts and display great nervousness. When a snake is worried and unhappy, it goes on a hunger strike.

Now, while snakes can fast more successfully than can warm-blooded animals, they are unable to go without food for any protracted time without growing thin. When a snake refuses food so long that it begins to show signs of emaciation, it is forcibly fed. In the case of small snakes this must be done very carefully. In the New York Zoological Park we take the snake out of its cage, hold it by its head, insert a funnel in its mouth, and pour down a well beaten egg. The small snakes, as a rule, are so delicate in their structure that it is inadvisable to attempt to force anything solid, like a mouse or a small bird, down their throats.

They Don't Eat in Hibernation

Usually snakes should feed every other week. But at certain times of the year they go into retirement, and during that period of rest they do not require food. In the North, snakes hibernate, or dig in, for the winter. In the tropics, they hibernate during the dry season. They do this because in the dry season the frogs on which the snakes feed disappear, so the snakes have to wait for food. If a snake is in good condition, with a supply of reserve fat, it can fast quite a long time. During the period of fasting the snake moves but little. This perfect rest prevents it from burning up its energy.

This Snake Fasted Twenty-two Months

The longest snake fast that has come under our observation at the Zoological Park lasted twenty-two months. The snake that made this record had been eating a thirty- or thirty-five-pound pig regularly every other week. It was fat when it began its fast. In order to determine the length of time a snake would go without food, we decided to permit it to exercise its own will in the matter, even if it starved itself to death. Every two weeks food was offered it, and refused. At the end of the twenty-second month the snake resumed its regular meals as if nothing had happened. It had lost surprisingly little weight during its fast.

Mr. De Vry, of the Lincoln Park Zoo, has devised a machine for feeding unwilling snakes. It is a sort of sausage stuffer in which ground meat is placed. A five-foot length of one-and-a-half-inch hose is attached to the stuffer, and this is placed down the python's throat to its stomach. The chopped meat is then forced through the hose.

In the New York Zoological Park we adopt a different method. The snake is taken out of its cage, stretched out full length, and a number of men hold it so that it cannot coil or curve itself. Then we take three rabbits that have been killed and skinned, and tie them together with string. A long stick is attached to the skull of the first rabbit, and the meal is forced down the snake's throat.

Snakes in captivity are usually fed killed food because giving them living dinners sometimes causes endless trouble.

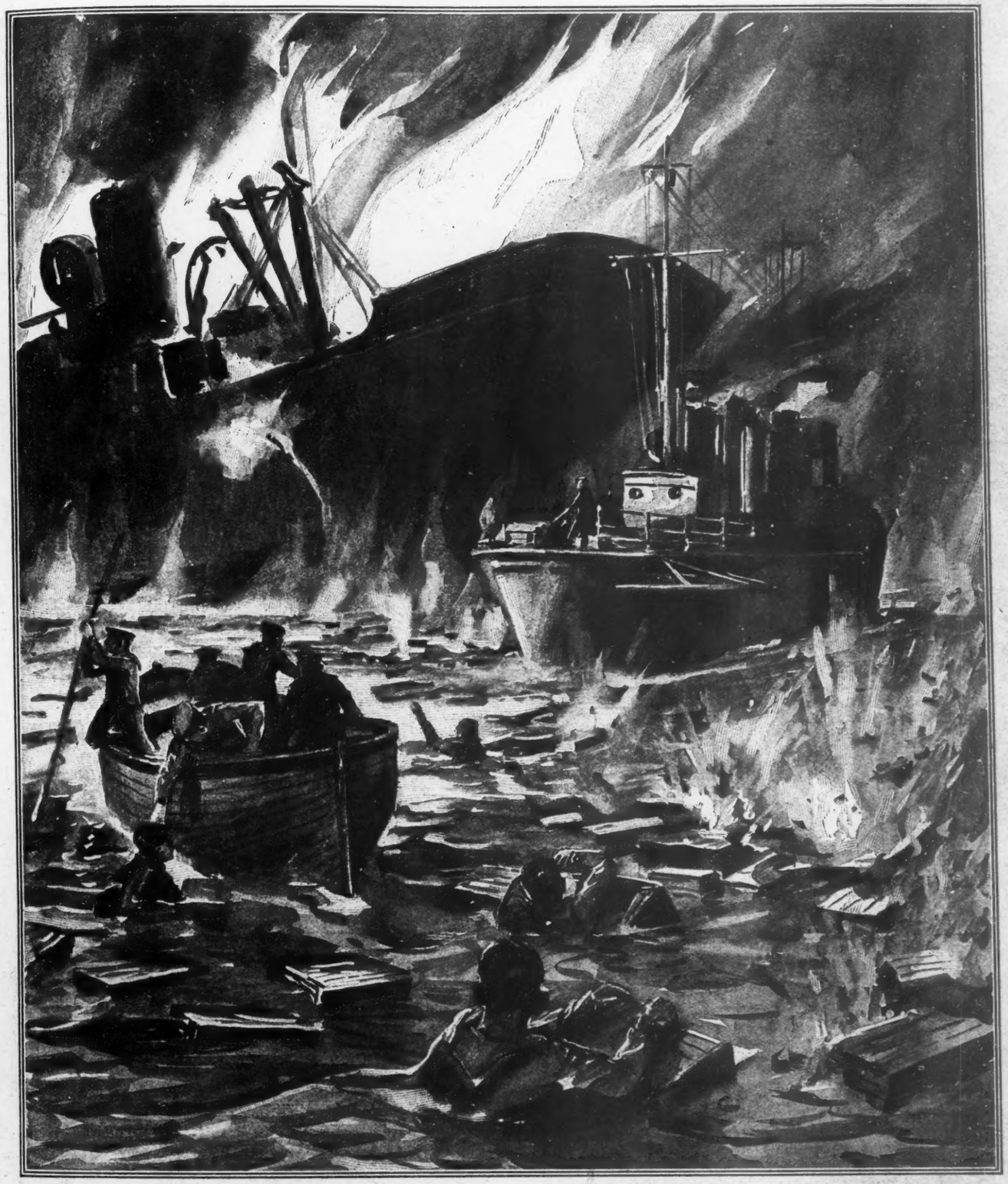
The Chicken that Killed a Snake

I recall an instance where a live chicken was placed in a snake's cage. The snake approached the bird and darted out its forked tongue. Instead of cowering miserably and permitting the snake to kill it, the chicken jumped for the snake, seized its tongue, and pulled it out. The wound caused the snake's death. As snakes are valuable, the practice was discontinued.

Lower picture: Out in Chicago, at the Lincoln Park Zoo, Mr. De Vry (the man with the cigar) has devised this modified sausage stuffer for feeding snakes

Upper picture: When a big snake in the Bronx Zoo refuses its food too long for its health, Mr. Ditmars stuffs three rabbits down its throat with a long pole

Through an Inferno to the Rescue



One night last April, the freighter *Florence H.*, loaded with smokeless powder and fixed ammunition, took fire in the harbor of a French port. The powder was in boxes piled up on the deck. For some unknown reason, it did not explode, but burned like a volcano, and the ship sank in ten minutes.

When she went down, the burning wreckage in the water was so thick that small boats coming to the rescue could make no headway through it; and the intense heat prevented converted yachts from coming near. Boxes of powder made up a great part of the wreckage, and these flared up continually.

In the middle of this floating inferno were the thirty-four survivors of the crew, swimming or holding to some of the boxes, in peril of their lives. There seemed to be no way to reach them, until Lieutenant Harvey S. Haislip, commander of an American destroyer, cried: "Damn the powder! Go ahead!" (or something like that), and sent his destroyer at full speed through the wreckage, opening lanes for the boats, which brought in all of the survivors.

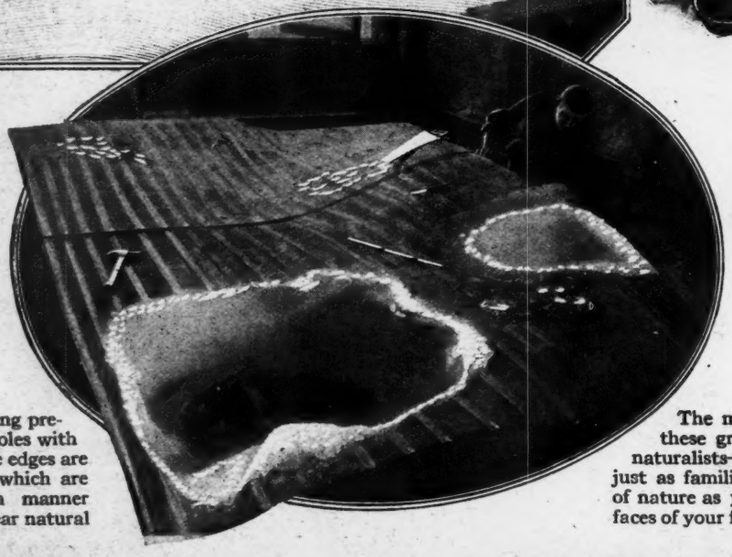
The American admiral in charge at the port and the French admiral of that district said all kinds of handsome things about the Lieutenant in their reports, and recommended some of his crew for medals.

Setting the Stage for a Museum Group

Photographs by courtesy of the American Museum of Natural History

If it were not for the lights you see at the top of this picture, you might think it a photograph of wolves on a trail. But it is one of the remarkably life-like groups on exhibition at the American Museum of Natural History

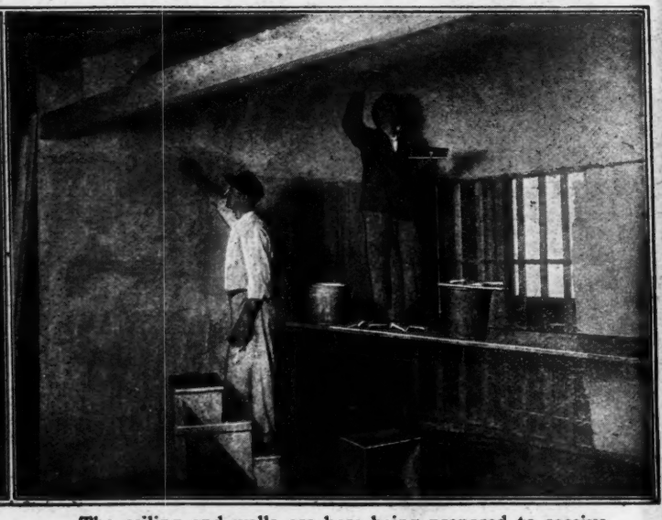
The trees are not as solid as they look. They are constructed of light wood frames, which are covered with bark. Snow and moss are then added so realistically that it is difficult to believe that the tree is not growing in the woods



Here the floor is being prepared. The large holes with the snow around the edges are left for the trees, which are placed in such a manner that the drifts appear natural

The men who prepare these groups are trained naturalists—men who are just as familiar with the face of nature as you are with the faces of your family and friends

This shows the earlier steps in the preparation of a group. The frame of the case for the exhibit is built of wood and wire. All the materials entering the construction are of the finest quality. There must be no danger of cracking or warping after the group has been put on exhibition

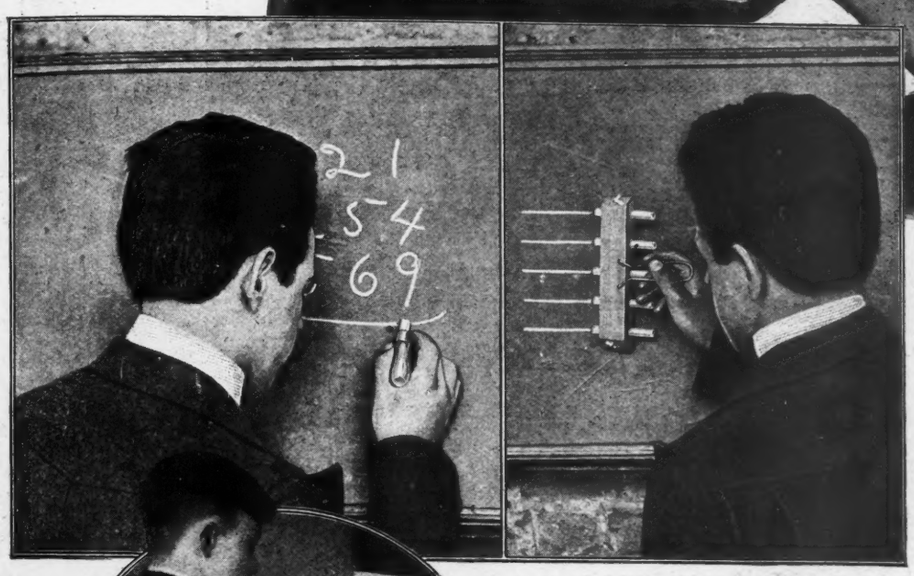


The ceiling and walls are here being prepared to receive the final painting of sky and landscape that makes the finished exhibit so true to life. The background is painted on the walls, and the ceiling is tinted so as to give a perfect illusion of snow-covered landscape and wintry sky

How Did They Ever Get Along in Father's Day?

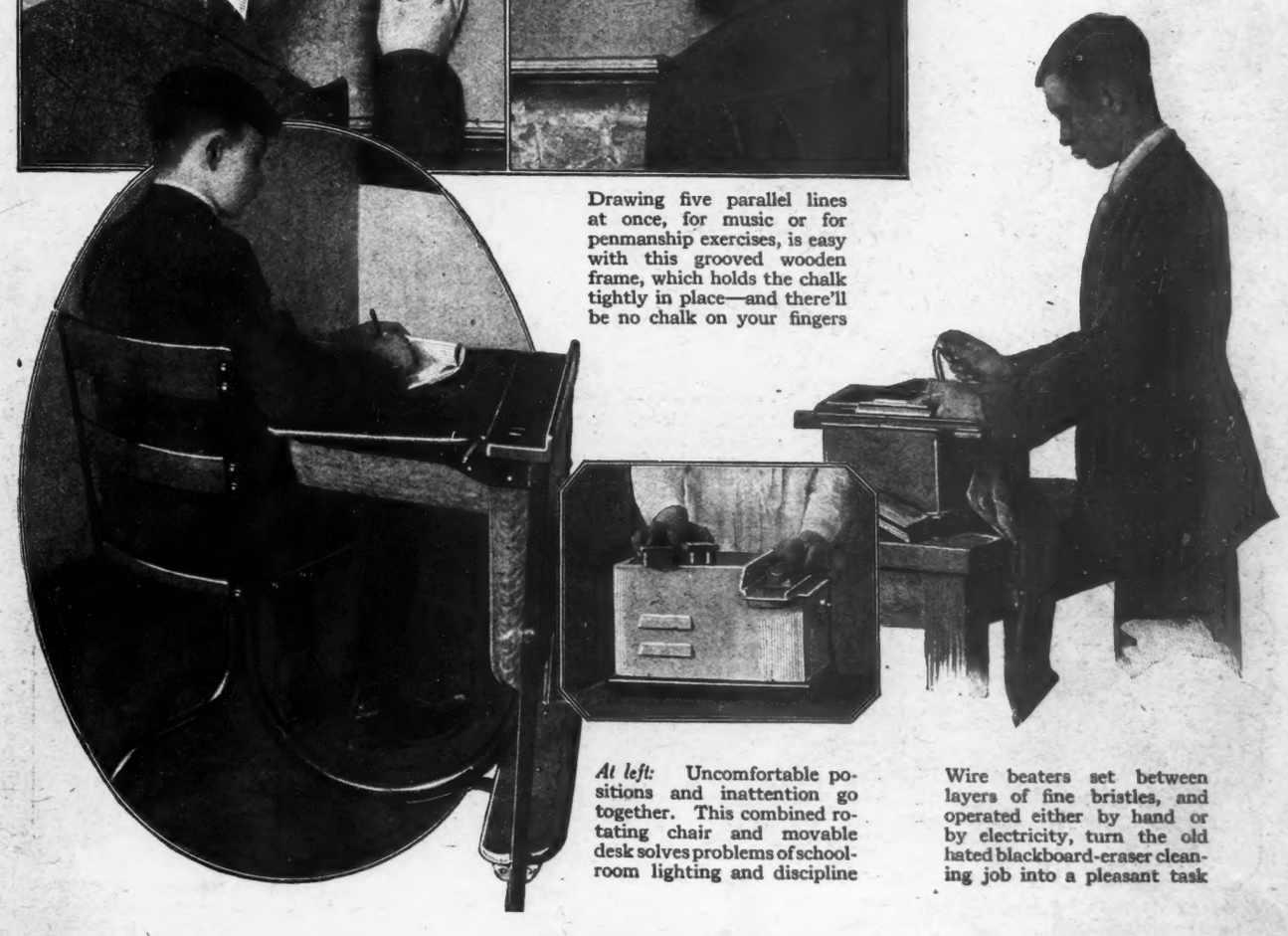
Mechanical aids that make life easier for the school-boy

"Teacher, my crayon's broken." "Very well, Johnny. Take the new holder, put the chalk in the slotted end, push down the metal ring to make it tight, and go on with your work"



With this post-card size duplicator, getting out school announcements is fun. The original copy may be made on the typewriter with a special ribbon, or with special ink applied by pen

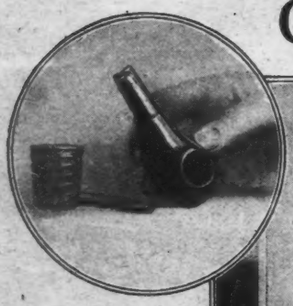
Drawing five parallel lines at once, for music or for penmanship exercises, is easy with this grooved wooden frame, which holds the chalk tightly in place—and there'll be no chalk on your fingers



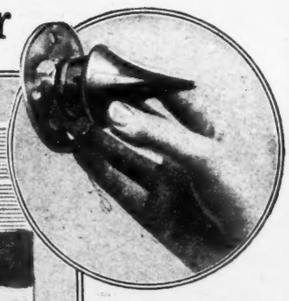
At left: Uncomfortable positions and inattention go together. This combined rotating chair and movable desk solves problems of schoolroom lighting and discipline

Wire beaters set between layers of fine bristles, and operated either by hand or by electricity, turn the old hated blackboard-eraser cleaning job into a pleasant task

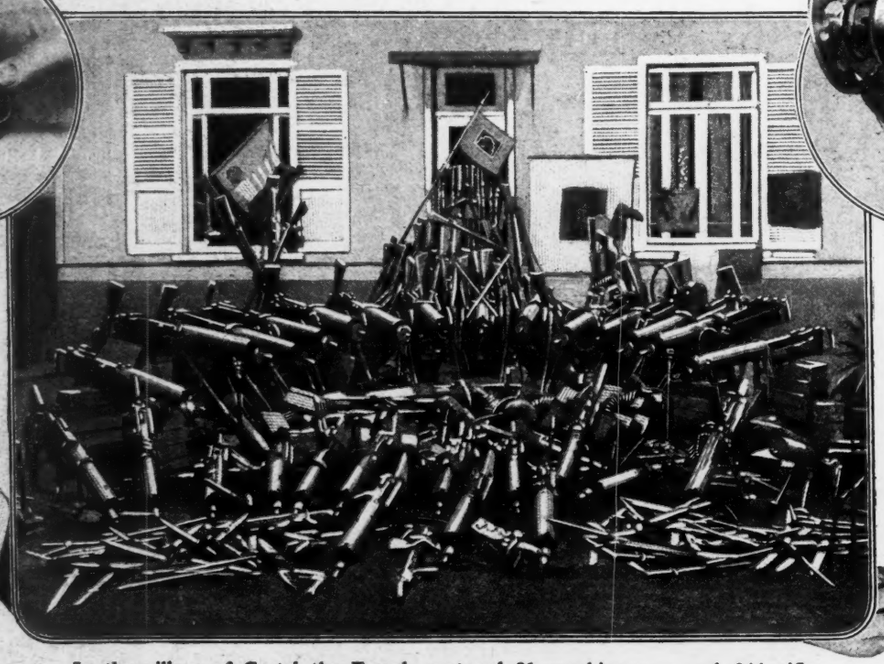
Cast Up by the Red Tide of War



A Belgian soldier's pipe showing five notches; and another made from the fuse-head of a shell

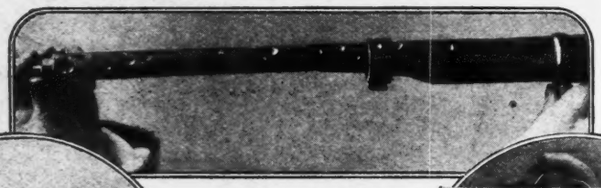


The spike of a helmet taken from the body of a dead German. It had been pierced at the base by a bullet

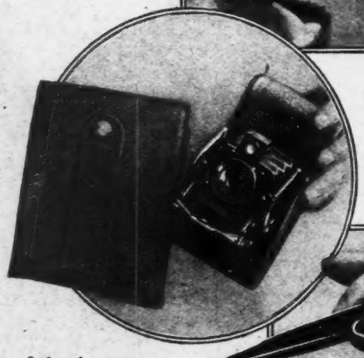


In the village of Castel the French captured 31 machine-guns and 244 rifles

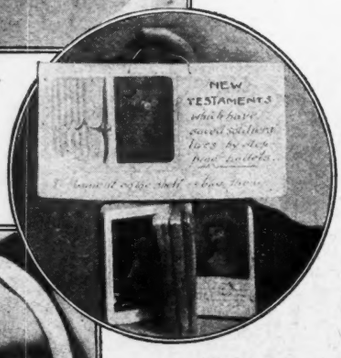
The incendiary Zeppelin bomb, the remains of which are shown above, killed a woman and injured her husband at Southend, England



The barrel of this Belgian rifle was struck at various times by more than thirty bullets



Private Perry, of the Australian Signal Corps, thanks his lucky stars that he took his camera to Gallipoli with him. A Turkish bullet hit the lens after passing through the case



No war is complete without a Bible that saved a life. The New Testament shown here was carried by a private through the early battles of Ypres and Neuve Chapelle

The "knuckle-scratcher," or hand bayonet, is an ideal weapon for "infighting." It fits snugly into the palm of the hand, allowing the owner to get a fine grip

One Australian was able to get away from Gallipoli because he did his sightseeing through a periscope. A Turkish bullet became lodged in the upper end

A woman who was struggling in the water after the *Hesperides* was torpedoed picked up this piece of cork, and it kept her afloat

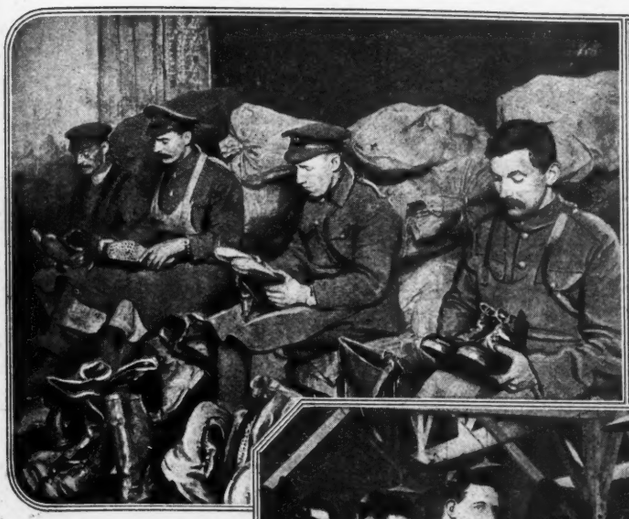
It's a German bucket. The removable cover serves as a dish, while the removable spoon is also a handle for the lid

This pistol, once owned by a Napoleonic soldier, was found in digging a trench in France

When a Krupp shell burst in the roof of an English house, this 12-pound piece buried itself in a bed, without injuring two children

Headless, gaily colored, lost by some Belgian child, this pathetic souvenir was picked up by an English marine

Keeping the Army on a Good Footing

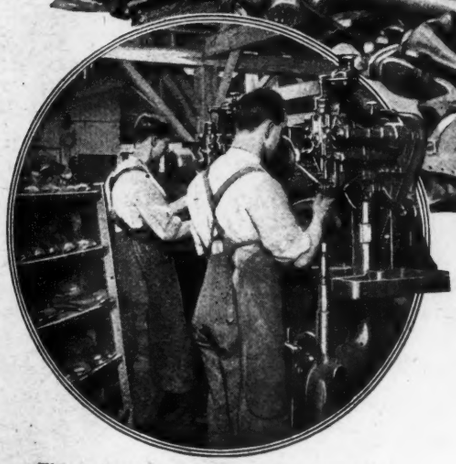


Soldiers are as hard on their footwear as a growing boy. In this shop back of the British lines, 30,000 pairs of shoes are repaired every week. The first thing is to see if the shoes are worth the cobbler's time

Stitching seams in a corner of the busiest repair shop in the world. In a modern army nothing is allowed to go to waste. Every bit of equipment is salvaged and sent back to be worked over

Another stage in making battle-worn boots ready for the trenches again. If a man can't fight, he can help keep the army on a good footing. When the hammers get going they sound like rapid fire

A stitch in time puts many a pair of soldiers' shoes back on the firing line, and the work allows disabled soldiers to keep on whipping the Hun



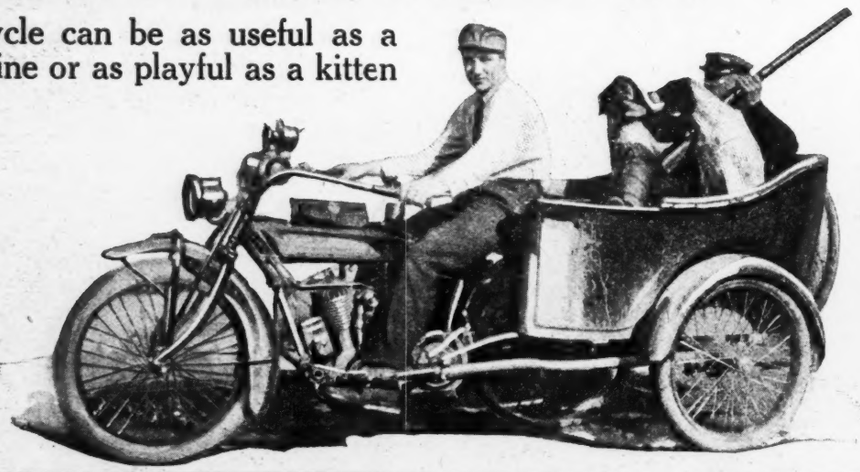
The hob-nails that grip the ground and enable the fighting man to get every ounce of his weight into a bayonet push are put on by machinery

Part of the 30,000 a week output of made-over boots now as good as new and ready for the feet that will chase the Germans out of France

Photographs © Underwood & Underwood

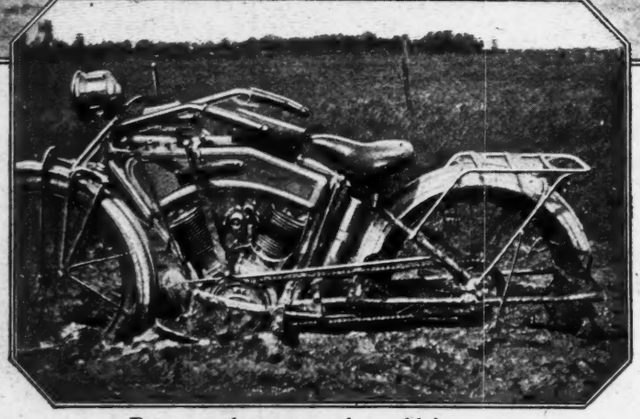
Gasoline Bronchos in War and in Peace

The motorcycle can be as useful as a sewing-machine or as playful as a kitten



At Wading River, Long Island, they go hunting in motorcycles. Even the dogs are spared unnecessary effort, and they ride in the rear car as if they were thoroughly used to gasoline locomotion

When we were boys we used to marvel at the broncho busters of Buffalo Bill's Wild West show. But what were the cavorting mustangs of that time compared with the bucking motorcycles of today?

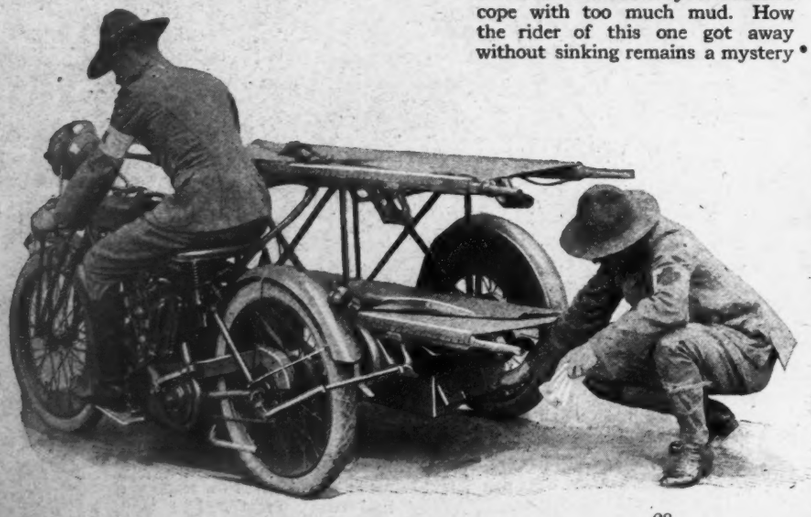


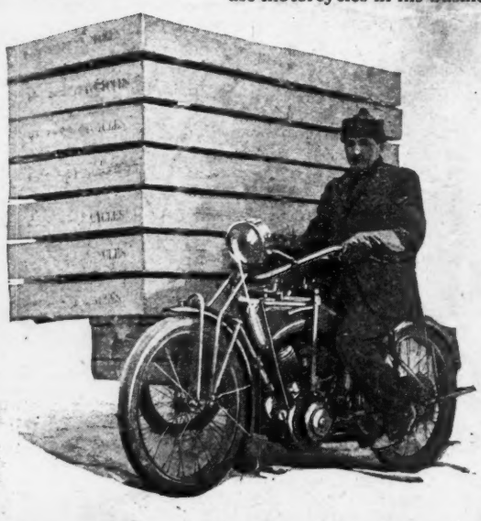
The motorcycle despatch rider in France must combine the adhesiveness of a cow-puncher with the mechanical skill of an automobile racer. So, hurdling on a gasoline motor is regarded as all in the day's work

The stretcher-carrier in the equipment shown below is double-decked, so that two wounded soldiers can be accommodated each trip. A first-aid cabinet beneath the lower stretcher makes it possible to dress wounds on the battlefield

And what may T. L. Bird be carrying in the huge crate on his side-car? A load of bicycles, gentle reader; for T. L. is the side-car agent of a motorcycle manufacturing firm. It is natural for him to use motorcycles in his business

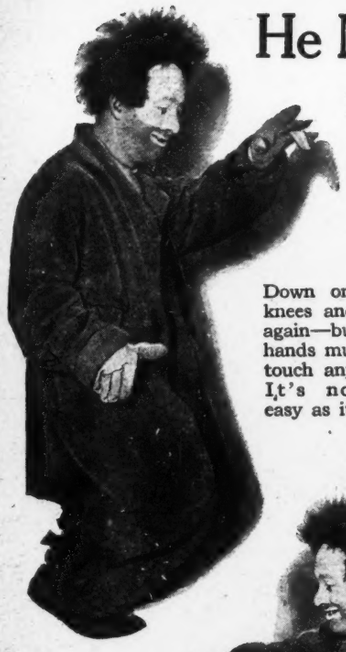
But even the motorcycle couldn't cope with too much mud. How the rider of this one got away without sinking remains a mystery





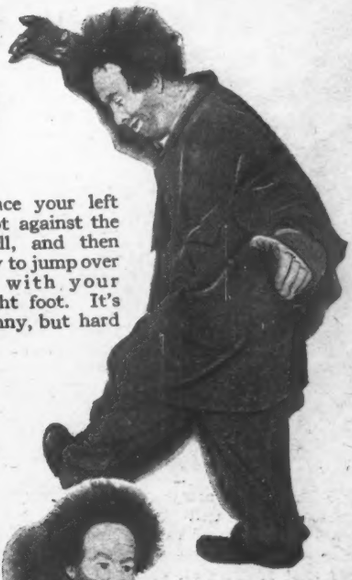
He Makes Thousands Laugh

Bluch Landolf, of the New York Hippodrome, poses for the "Popular Science Monthly"



Down on your knees and back again—but your hands must not touch anything. It's not so easy as it looks

Place your left foot against the wall, and then try to jump over it with your right foot. It's funny, but hard



This is the middle position of the "roly-poly." Landolf simply lets his body roll backwards and forwards and from side to side, while five thousand people laugh until the tears run down their cheeks

When Bluch Landolf begins the "roly-poly," he sits down and grasps his feet firmly, like this

Finally he winds up the "roly-poly" exactly as he began it—sitting on the floor and grasping his toes

Crouch on the floor and support your body on your hands. The head and feet must be up. This is Bluch Landolf's "floor balance"

Hold your toes and jump forward, but without releasing the grip of your fingers. It takes an acrobat to do this without toppling

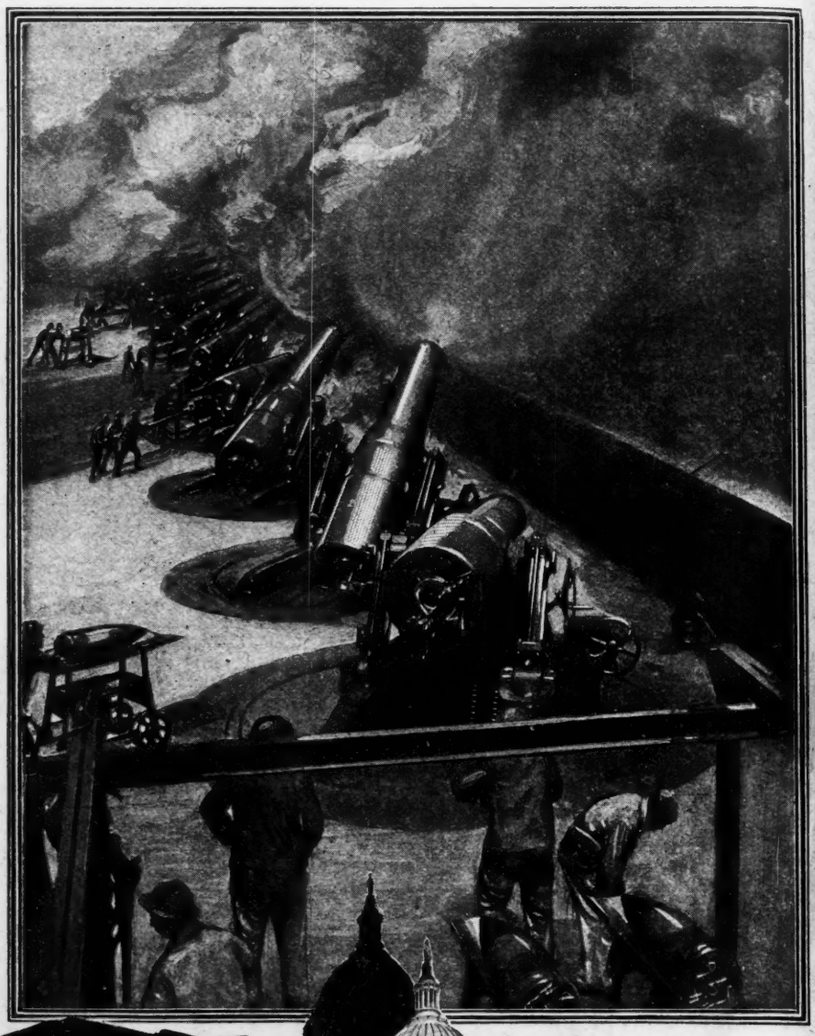
Another position of the "down on your knees and back again" trick shown at the top of this page

Straddle the chair seat and lift yourself up and down by your arms. If you can do it at all, you will find yourself puffing at the end of half a minute

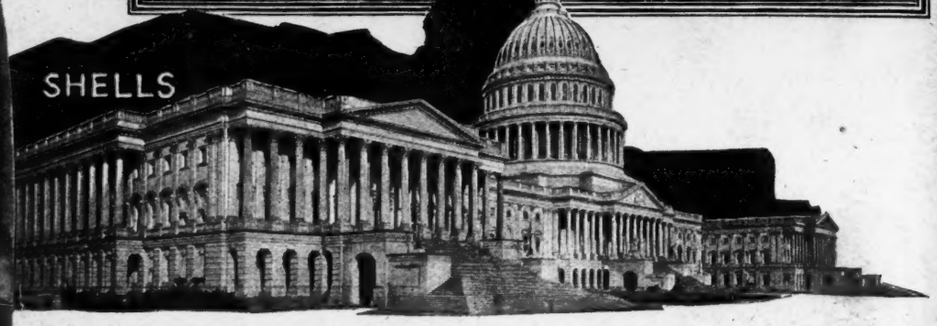
Hold one leg out straight and then try to jump backwards. Without practice you will probably lose your balance

We'll Win the War with Shells—and Dollars:

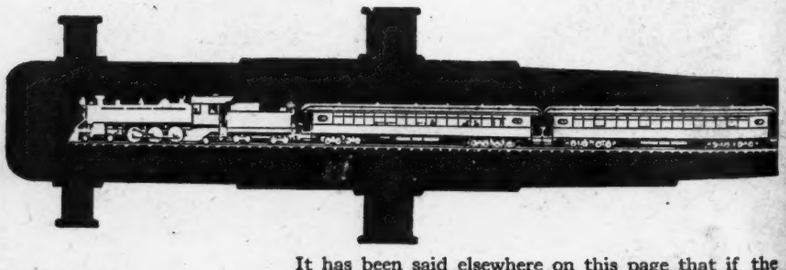
Every one knows that the consumption of ammunition in this war is stupendous. But what of the labor entailed in manufacturing that ammunition? What of the ore that has to be mined and of the coal that has to be dug in order to smelt the ore? In the battle of Picardy, for example, the Germans violently bombarded the American lines, but they succeeded in killing only five Americans for every 85,000 shells fired. Nearly 400 cannon were in action. To make 85,000 shells requires the work of 2,000 coal-miners and 700 iron-miners for a period of a day



The American army of more than two million men will be equipped with 8,000 field-guns of various caliber. If it were possible to concentrate their energy into that of one gun, that gun would have a bore eight feet in diameter, and its length would be 400 feet. The projectile (*below*) that it could fire would weigh 180 tons, and the length of the projectile would be about forty feet



The American program for the manufacture of shells is such that 6,850 of them could be fired per mile each day along a front of one hundred miles. If that is so, our factories must be able to turn out 250,000,000 shells a year, weighing 5,000,000 tons in all. If the figure is correct, then every two months a solid pile of shells will be obtained as big as the Capitol at Washington. We must leave it to the imagination to picture a year's output

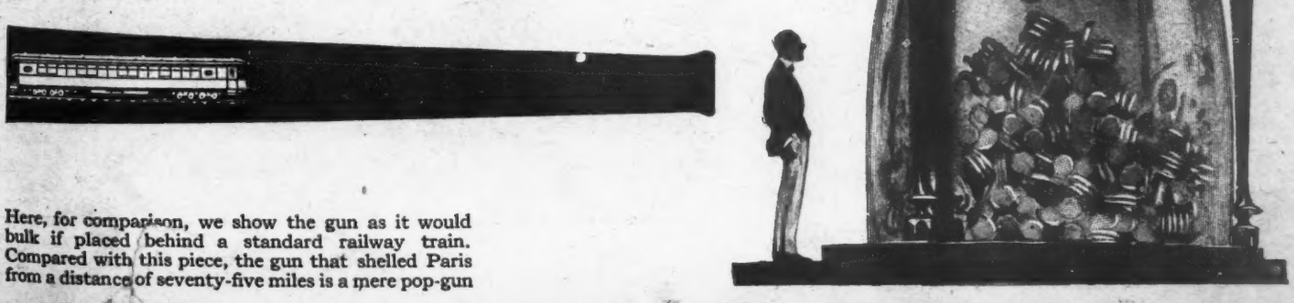


It has been said elsewhere on this page that if the energy of the 8,000 field-guns with which the American army is to be equipped could be concentrated in a single gun, that gun would have a length of 400 feet

Staggering Figures that Explain War Cost

Here is a crowd of sixty thousand people attending a football match in the Yale Bowl. Suppose every one of these sixty thousand people to be worth eight and a half million dollars: their combined capital would then just about equal the total national wealth of the seven principal nations at war, this estimate relating to conditions just before the war. The five main Allies were worth $406,000,000,000 —about four times as much as the Central Powers, who were worth about $105,000,000,000

Hour by hour, an unceasing stream of dollars flows to meet the expense of the war. This flow might be used to measure the passing time, after the manner of the sand-glass of the ancients. The four and a half million silver dollars that would thus fall each hour from the upper into the lower ball of the glass would require a structure about thirty feet high to perform this function



Here, for comparison, we show the gun as it would bulk if placed behind a standard railway train. Compared with this piece, the gun that shelled Paris from a distance of seventy-five miles is a mere pop-gun

Many Are the Makeshifts of War

French official photograph

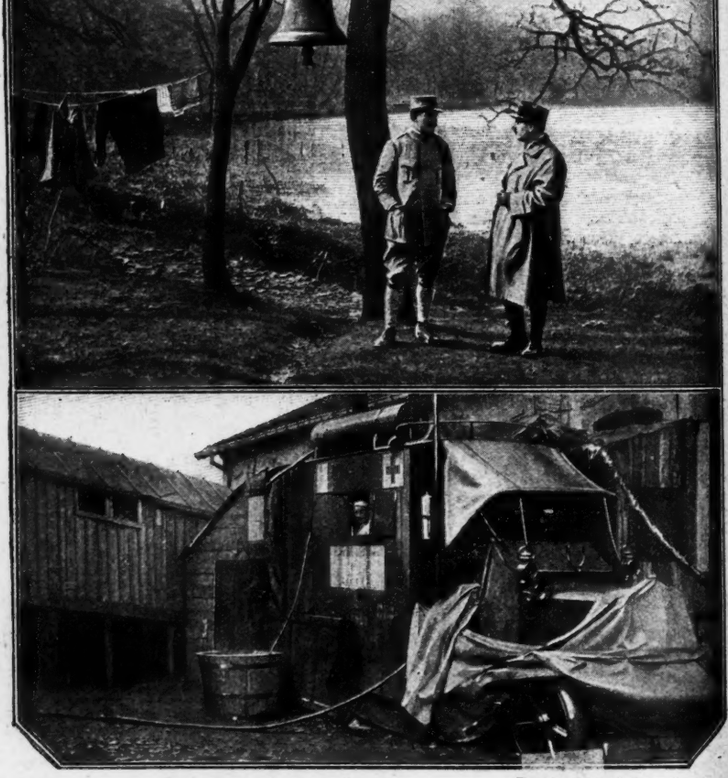
Above: After "they shall not pass" had been made good at Verdun, a garden-loving French soldier turned this German helmet into a flower-pot to decorate his trench hut

French official photograph

Above at right: The corrugated iron sides of this cottage, with a fine battlefield view, served as important parts of a bomb-proof until the German tide was rolled back

Most streets in Flanders are canals, and so bridge-building is the national sport. Duckboards from the trenches will do for material at a pinch when the army moves forward

British official photograph



At right: Salvaged from the ruins of the village church, this bell continues in service. Its belfry is a tree, and it clangs out daily warnings against gas attacks

Below: The enemy's own shells carved this giant stump into a front-line observation post, for which Nature herself had already supplied a most effective bit of camouflage

French official photograph

French official photograph

"Dead and done for," said the chauffeur. But the Red Cross man came along and turned the abandoned automobile into a cozy hut

Sowing the Ocean with Death

By Waldemar Kaempffert

WHEN the Germans ran away from Admiral Jellicoe in the second great naval battle of the North Sea, it was the mines that had been planted in huge numbers in the waters surrounding the island of Helgoland that saved them from defeat. Jellicoe said as much in his report. He knew that he was rushing into waters literally sown with the seeds of death. England's Grand Fleet was much too precious a possession to be foolishly risked, and so the pursuit came to an end.

Suppose that Jellicoe had followed Farragut's example and said, "Damn the torpedoes!" (and Farragut's "torpedoes," be it remembered, were very crude mines of uncertain action): suppose that he had steamed boldly on after that long veil of smoke, ten miles distant, which he knew to be the fleeing Germans—what would have happened?

Carefully concealed beneath seventy feet of concrete on the island of Helgoland is a large underground room, one entire wall of which is a huge chart of the waters that surround the island. It is not an ordinary map, this chart; for it is studded with electric lamps. Each lamp marks the position of a mine containing from five hundred to one thousand pounds of the deadliest high explosive that a diabolical ingenuity was able to discover. An officer sits at a desk, facing the wall-chart.

The Chart that Means Death

Miles and miles away is Jellicoe. The officer cannot see him. And yet, as soon as Jellicoe enters the mine-field, that officer knows it. A light flares up. Then another and another and another. The lights do not glow steadily: they flash intermittently. The officer at the desk has only to watch the wall-chart. The lights tell him exactly what course Jellicoe is pursuing, and, moreover, the speed and tonnage of the intruding ships.

He bides his time. Then comes a moment when half a dozen super-dreadnoughts have entered the toils. He picks up a telephone: "Group mines 23, 45, and 57. Fire!" He has scarcely hung up the receiver when, twenty miles out, a few terrific explosions toss up geysers of water high into the air, and three battleships, manned by a total of forty-five hundred men, are literally blown asunder.

To the deadly high explosive is added a little mono-nitro-naphthalene, one purpose of which is to create a cloud of jet-black smoke

Jellicoe knew that Helgoland is the Gibraltar of the North Sea—knew that it is the heart of an invisible spider's web from which there is no escape when once it has been penetrated. He must have seen, in his mind's eye, some such picture as that which we have painted. He knew that it was madness to pursue.

Through the courtesy of a neutral officer who was employed by the German government to construct and install the mine system of Helgoland and Kiauchau, and by the Austrian government to mine the waters of Pola and Fiume, the POPULAR SCIENCE MONTHLY is able to present its readers with the following account of a modern mine-field. The officer in question has made the development of submarine mines, of explosives and detonators, a life study, and has been employed as a submarine-mine engineer by different European governments.

Only a Hundred Submarine Engineers in the World

There are probably not more than a hundred men in the whole world who are competent to design and plant a mine-field; and most of them are officers whose governments have spent large sums of money in training them. The installation of a mine-field has become a very difficult and special branch of engineering, involving a knowledge of chemistry, electrical and mechanical engineering, metallurgy, and a dozen other sciences.

To protect the waters of a harbor or the mouth of a river, either contact or observation mines, or both, are planted. As its name indicates, a contact mine explodes when it is struck by a passing vessel. An observation mine, on the other hand, is electrically exploded from a shore station at the critical moment by a watchful officer.

A contact mine is spherical, cylindrical, or of frustum shape. Just what shape of contact mine is to be selected depends on the size of the mine, the depth of the water, tide conditions, and other circumstances. It contains from one hundred to one thousand pounds of high explosive—T.N.T.,

As the ship enters the mine-field its wash and suction cause the vanes of the nearest signal-buoy to swing from side to side. An electric circuit is thus made and broken, so that a lamp, indicating the position of the particular buoy affected, flashes intermittently in a shore station. To send the ship to the bottom, it is only necessary that the mine nearest the signaling buoy be fired

dynamite, or guncotton—and a little mono-nitro-naphthalene, the purpose of which last is to break up the explosive into very small particles and to create a cloud of jet-black smoke which envelops the stricken vessel and which serves as a telltale.

Contact and Observation Mines

How is the contact mine exploded? Its upper surface is studded with steel pins, the protruding heads of which are protected by glass domes. Sensitive as a mine must be, it must not be uselessly exploded by a mass of driftwood. Hence the glass of the domes is of such thickness that it can be broken only by a blow of more than one hundred pounds to the square inch. Such a blow can be delivered only by a fairly large, rapidly moving body, such as a ship. When that happens, a steel pin is driven into a quick-acting primer, the chief ingredient of which is fulminate of mercury; or a vial of sulphuric acid is broken and poured on chlorate of potash. In either case there is a terrific explosion.

An observation mine, on the other hand, contains detonating devices of a different character. A ship may ride over or even collide with an observation mine without causing an explosion; for the mine is set off by an electric spark, which passes only when a firing-key on shore is depressed.

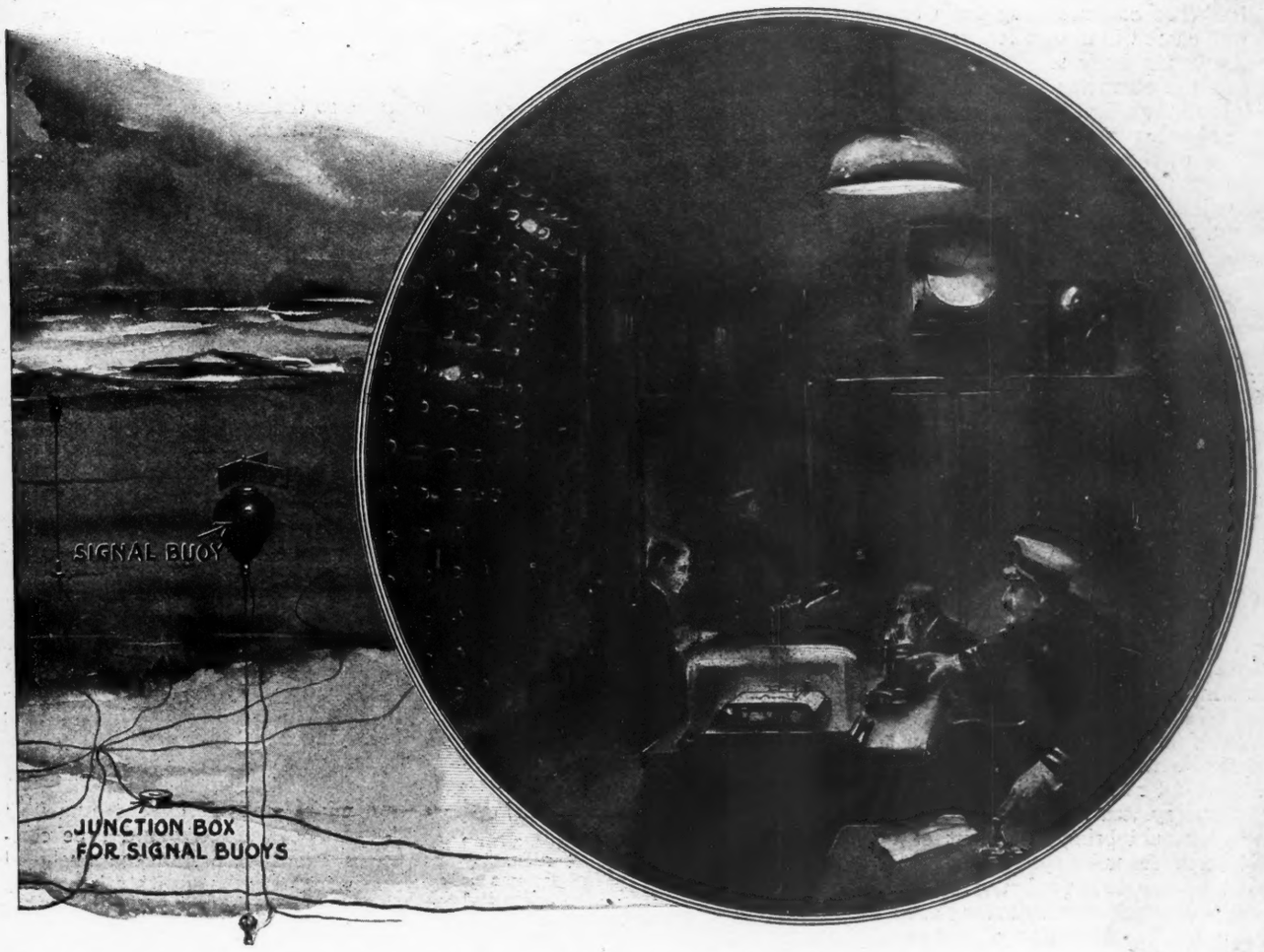
The difference between the old muzzle-loader, with which the Civil War was fought, and the modern breech-loader is no greater than the difference between the "torpedo" of Farragut's day and the mines with which Helgoland is protected. In truth, a mine is now so complicated a piece of deadliness that it cannot be prepared overnight. And mine-fields are so vast that they are usually laid out in time of peace, when there is not a single cloud on the political horizon.

Now, it is obvious that a waterway may not be mined in time of peace without becoming a menace to peaceful shipping. So a type of mine is used which, although anchored, can be raised and lowered as easily as you turn a light on and off. In the anchor-base of the mine is a drum on which the mine-cable is wound. By means of a compound-wound electric motor, which is mounted in the base of the mine, the cable on the drum can be wound or unwound, so that the mine attached to the cable is lowered or raised. The construction is disclosed in such detail by diagrams on page 36 that an extended description here is unnecessary.

The Mine in Time of Peace

In time of peace the mines slumber harmlessly near the bed of a waterway; no ship's bottom can touch them. At the first sign of war a few switches are moved in a shore station; the motors in the mines turn; cables are paid out from their drums in the anchor-bases; and in fifteen minutes a safe fairway becomes a death-trap!

Like every floating body, a mine swings with the current. As a result, its moorings may foul and it may be exploded. To overcome this very grave objection the fin mine has been adopted. You have noticed how a ship swings at anchor with the tide around its moorings, always pointing head-on to the current. The same effect is secured by the simple expedient



Each lamp on the wall corresponds with a signal-buoy in the mine-field. The course of a ship can be traced by watching the lamps. On the desk is an instrument which records the course taken by a vessel on a ribbon of paper, the pen being actuated by electrical pulsations sent out by the buoys that cause the lamps to flash. It remains only to press a key to send the ship to its doom

of equipping a mine with a fin. A mine is thus transformed into a little anchored ship, the fin of which constantly keeps it in the same relative position to the current. It swings through an angle of 180°, and its cable never fouls.

Obstacles to Anchoring Mines

To anchor a mine would seem to be one of the simplest of problems. Yet it is one of the most difficult. The bottom of a river, or of a bay, is usually treacherously soft. A heavy weight would be simply swallowed up in that slimy mass. In sowing the mouth of a South American river with mines, it was found that the deposit of silt not only engulfed the mine anchors, but even dragged the mines themselves down. Hence, the mine engineer who was in charge of that work, and to whom we are indebted for the facts on which this article is based, invented a mine anchor which has a mushroom-shaped suction-disk that remains wherever it is planted.

But mud, silt, and quicksands are not the only difficulties to be overcome. Our mine engineer, while engaged in planting mines in the English Channel, found that he had to contend with galvanic action. At first he could not understand why anchors and cables corroded, so that the electrical indicating mechanism in the mine was completely deranged. To be sure, he knew that galvanic action was responsible for his troubles. But what set up the galvanic action?

He determined to explore the bottom of the channel. A dredge scooped up for him—what? Oysters. But they were not normal oysters. Their shells were a lovely green, and the green meant that they were impregnated with copper.

Then he knew why he had to deal with galvanic action, and why he had to devise a method of overcoming it.

It has been said that at Helgoland the officers in charge of the mine-field watch lights on a wall-chart in order to determine the speed, size, and location of an intruding vessel. What makes the lights flash? Signal-buoys connected with the shore station. Study the illustration at the top of page 36, and you will see at once how they operate.

On top of the buoy is a vane so mounted that it can swing freely with a kind of turntable constituting the top of the buoy. The wash of a ship agitates the water, and the vane swings excitedly from side to side.

How Ships Betray Themselves

As the illustration shows, the turntable on which the vane is mounted carries an arm, which arm is moved toward and from an electric contact as the vane swings. When the arm touches the contact, an electric circuit is completed; when the arm moves away from the contact, the circuit is broken. An armored, non-corroding cable electrically connected with both the arm and the contact runs through the bottom of the signal-buoy to the shore station and to a light on the wall-chart.

It is easy to see what happens. As soon as a ship approaches the fatal buoy, its suction and wash sets the little vane in motion. The bigger the

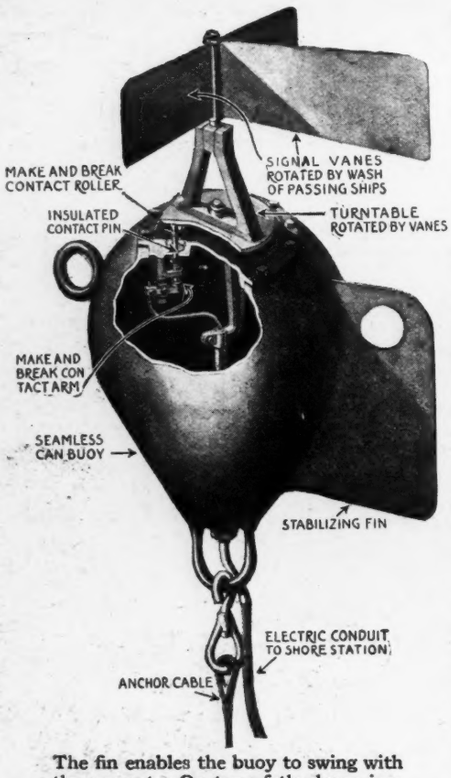
ship, the more tremulous the vane will be. The corresponding lamp on the wall-chart will flash whenever the arm within the buoy touches the contact, and the character of the flashes will inform the officer whose eyes are glued on the chart what is the probable tonnage of the ship that has blundered into the toils. It is just as if he had magically transported himself miles and miles out into the North Sea and seen the ship for himself. He watches lamp after lamp flash up on the chart; the ship's course and speed are traced in lines of light. He has but to give an order, and the mine nearest a given signal-buoy is fired.

Grouping Mines for Firing

There are hundreds of such telltale buoys in a mine-field as expansive as that of Helgoland. And there are thousands of mines. The Germans spent about $75,000,000 on the Helgoland mine-field, not to mention powerful shore batteries. Each buoy is electrically connected with the shore station, and each observation mine as well. Clearly, a maze of wires must run into the station. The switchboard of a large New York telephone station is no more bewildering than the switchboard to which the wires of the Helgoland mines lead.

Some system had to be discovered which would bring order out of this apparent chaos—a system that would enable a man to fire only the right mine or group of mines. A similar difficulty confronts the inventor of automatic telephone exchanges—exchanges which do away with switchboard girls entirely and enable you to make your own connections with any person you please. One pressure of the firing-key, and he has exploded either one mine and destroyed a light cruiser, or fifty mines and annihilated a whole battle fleet.

A complete record is automatically made of every ship that enters the Helgoland mine-field or other fields like it. The signal-buoys are connected not only with the lamps on the wall-chart, but also with a registering instrument. Through that instrument a web of paper travels; and on the paper, in response to the electrical pulsations sent out by the corresponding signal-buoys, a pen traces the course taken by a vessel through the mine-field in time of peace or war. Thus a permanent record is kept of friendly and hostile visitors.


MAKE AND BREAK CONTACT ROLLER
SIGNAL VANES ROTATED BY WASH OF PASSING SHIPS
INSULATED CONTACT PIN
TURNTABLE ROTATED BY VANES
MAKE AND BREAK CONTACT ARM
SEAMLESS CAN BUOY
STABILIZING FIN
ELECTRIC CONDUIT TO SHORE STATION
ANCHOR CABLE

The fin enables the buoy to swing with the current. On top of the buoy is a vane, which is mounted on a turntable so that it can rotate. The turntable carries an arm which, when the vane swings, touches an electric contact. As soon as this happens, a lamp flashes in a distant shore station. By observing the signals sent by two or more of these buoys the direction and speed of the vessel can be estimated

Death is Certain, at Moonless Midnight or Sunny Noon

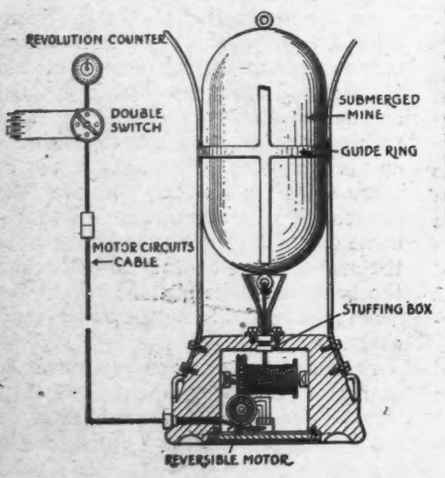
While it is not absolutely necesssary for the officer in charge of a station to see the waters around Helgoland, any more than it is necessary for you to see the person to whom you are telephoning, an observation tower is provided to which he can resort on occasion. He can fire smoke buoys if he so desires, and thus determine a ship's position, if for any reason the electrical connections of his signal-buoys should be interrupted. Moreover, some of the mines of the Helgoland field are provided with microphones, so that the location of a vessel can literally be heard through telephone ear-pieces. In fact, every possible contingency has been foreseen.

Now, it is evident that, with such a system, it is hopeless for a ship or a fleet to steal into a harbor in a fog or on a moonless night. The lamps on the wall-chart flash up just as surely at midnight as they do at noon. In some harbors of the world implicit reliance is placed on contact mines alone. At Helgoland contact mines are, of course, to be found in large numbers. But it is conceivable that a resourceful and venturesome enemy might devise some way of sweeping a channel clear of contact mines on an inky night. There is no way of escaping the observation mine-field and its betraying signals.

The Cost of a Mine

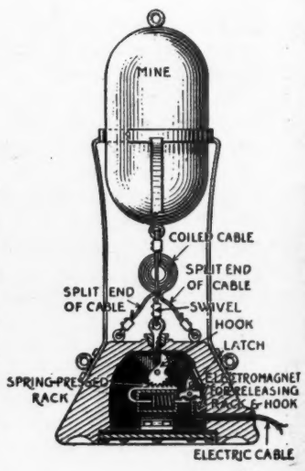
A mine-field is divided into "units." A "unit" of the Helgoland type comprises twenty-five hundred anchored mines, a central shore station, miles and miles of electrical connections, signal-buoys, and smoke buoys. It protects from ten to twenty square miles of water, and it costs from five million to six and one half million dollars, depending on the location of the field and the character of the bottom. Each mine costs from two hundred and fifty to sixteen hundred dollars.

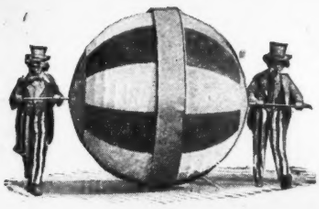
So efficacious is this system that at Kiauchau, where it was used, the Japanese, finding it too dangerous to take the town from the sea with ships, were compelled to violate the neutrality of China and take the town from the rear.



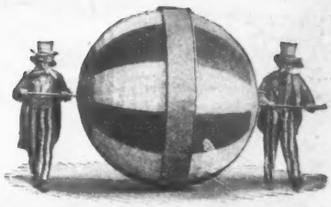
The mooring-cable of the mine at the left is wound around a drum turned by an electric motor. Gears on the ends of the drum mesh with worms on the shaft of a compound wound electric motor, so that the cable is wound up or paid out and the mine raised or lowered. The gears have independent clutch connections with the drum-shaft; so that, when one gear is in action to drive the shaft, the other turns closely on the shaft. Hence the one motor can either unwind the cable, so that the mine rises by its own buoyancy, or wind up the cable and pull the mine down

In the anchor base of the mine at the right is a hook which engages an eye and holds the mine down in time of peace. The hook is formed with teeth meshing in a U-shaped rack. One leg of the rack is pressed by a coiled spring; but the rack is held in the normal position by means of a latch. An electromagnet, when energized, releases the rack. When war is declared, a key or button in a distant shore station is pushed, and the hook withdrawn from the eye. The mine rises to a height determined by the uncoiling cable and can't be retracted





He Also Fights Who Helps a Fighter Fight



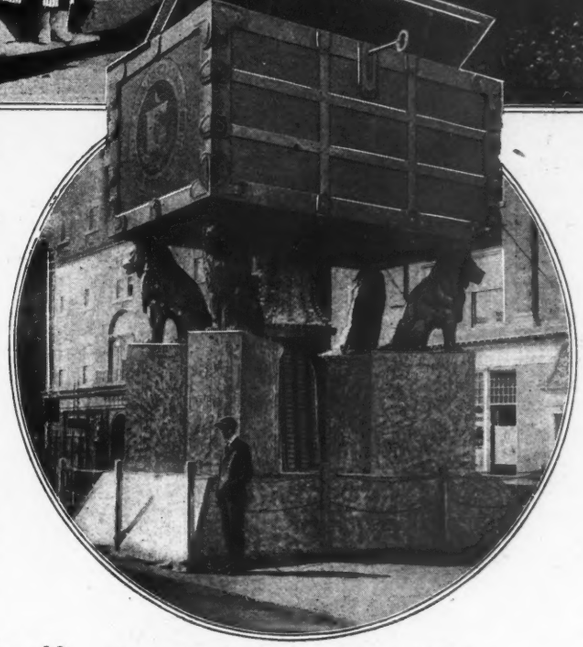
In one day's run this street-car sold $1,500 worth of thrift stamps

W. S. S. sales amounting to $3,430 were rung up the first day

Columbia—Thrift Stamp Car Conductor

UNCLE SAM was motorman, Miss Columbia conductor, of a red, white, and blue street-car lettered with exhortations to buy thrift stamps, which plied back and forth all one day between the Manhattan end of the Queensboro Bridge, across the East River, and Jamaica, Long Island, twenty-two miles away, over the line of the Manhattan and Queens Traction Corporation.

The car was a regular piece of the company's rolling stock, appropriately painted. Its crew sold $1,500 worth of stamps on their run the first day, besides doing a thriving business in carfares.



The pedestal of Salem's war chest is painted to look like stone. Four bronzed lions hold up the chest, which is ten feet wide, sixteen feet long, and eight feet deep. The key is four feet long

Giant Register to Record Patriotism

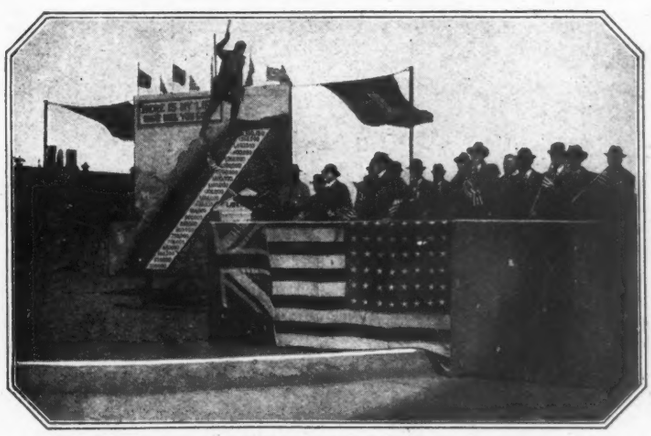
IN Indianapolis they rang (up) the changes of the Thrift Stamp and War Savings Stamp sales display by building a mammoth cash register across one of the business streets. It was more than thirty feet high, and nearly as wide. In the foundation was the headquarters for the sale of stamps.

When a purchase was rung up, an electrically connected bell in each district rang simultaneously.

Over the Top

AT the General Electric Company's plant in Schenectady, N. Y., during the third Liberty Loan campaign, the graphic daily bulletin of progress was the climb of a colossal silhouette of a soldier "over the top." The figure was attached to the background by pins that held it at any level desired. It went up one step (or one sand-bag, perhaps) for each $50,000 that was subscribed.

The last figure was the local quota, $1,550,150.



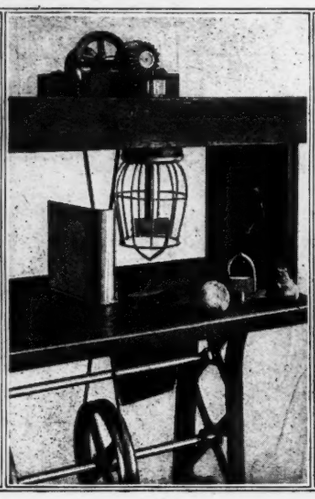
Each time an additional $50,000 was subscribed the figure went up a step. At $1,550,150 it went over the top

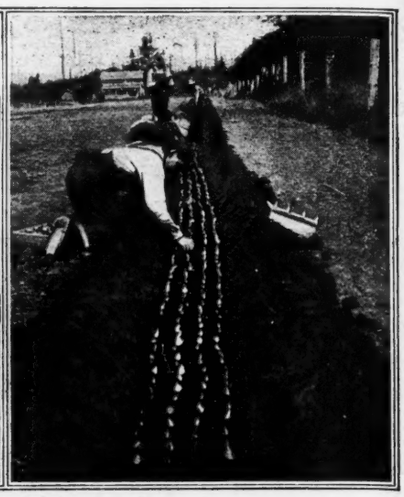
Salem's War Chest

IN the center of the page is Salem's war chest. The fine old city on Massachusetts Bay is one of those that have systematized contributions to all the war relief funds. Out of the total subscription—that is, the chest—a treasurer takes an appropriate portion for each cause.

Salem's chest is a real one, an enlarged edition of such sea-chests as Salem sea captains had in the old days. Salem wants $400,000 to fill the chest.

As searchlights play upon the chest all night, it seems improbable that anything short of a witch could rob the chest. And witches had better look out in Salem.





© Western Newspaper Photo Service

Harnessing the coffee-mill to a mountain stream meant a lot of work, but think of the fun of it

The practice of scooping bulbs has made it possible for American horticulturists recently to develop bulb-plant growing on a large scale

Grinding the Coffee by Water Power

NECESSITY is not always the mother of invention. The Alpini in the accompanying picture, who rigged up a small water-mill to harness the rushing mountain stream near their station in the Adamello region to a small coffee-grinder, were hardly prompted by necessity. Undoubtedly they had enough time; for, as a rule, the men stationed in the mountains have little to do when there is no actual fighting. Grinding coffee in the little grinders which the Italian Commissary Department supplies to the men at the front may be slow and tedious, but does not require any strenuous effort—not one tenth of the effort which the men in the picture had to exert in constructing and running their water-power coffee-grinder. They may not accomplish much, but the mere fact that "it works" evidently gives them a great deal of satisfaction.

"Dutch Bulbs" Are Now Grown in America

FOR centuries Holland has monopolized the production of bulb plants. Dutch bulbs, especially tulips and hyacinths, were shipped to all parts of the world, and lovers of such plants often paid fabulous sums for bulbs of some rare variety. Since the outbreak of the war, Holland's bulb industry has been almost wiped out.

Before the war America had been one of the best customers of the Dutch bulb gardeners, and so great was the interest in bulb plants that our Department of Agriculture in 1908 established an experimental bulb farm at Bellingham, Wash. There many rare varieties of bulb plants are grown, with marked success. Seed is used only in the case of very rare plants, because it requires from five to eight years to bring a plant to maturity from seed. In most cases new plants are grown from bulblets. Mature mother bulbs are scooped out, then placed on trays in a warm propagating house. In a few months a crop of baby bulbs develop around the scooped-out hollow.

Photographing the Baby—a Task for Experts

MORE years ago than we care to remember, "Photographing the Baby" was a favorite title for the efforts of comic artists and verse-makers. They aimed their shafts of would-be wit at the photographer at a time when his art was in its infancy, and when the iron head-clamp made wooden Indians of most grown-ups.

The photographer was pictured asking baby to "see the little birdie"—a birdie that long since flew away to join the other things that the march of progress has pushed to the rear. But the baby still remains a problem. A POPULAR SCIENCE MONTHLY photographer recently caught a group of moving-picture men trying to film a lively youngster while waiting on Fifth Avenue, New York, for a parade to start.

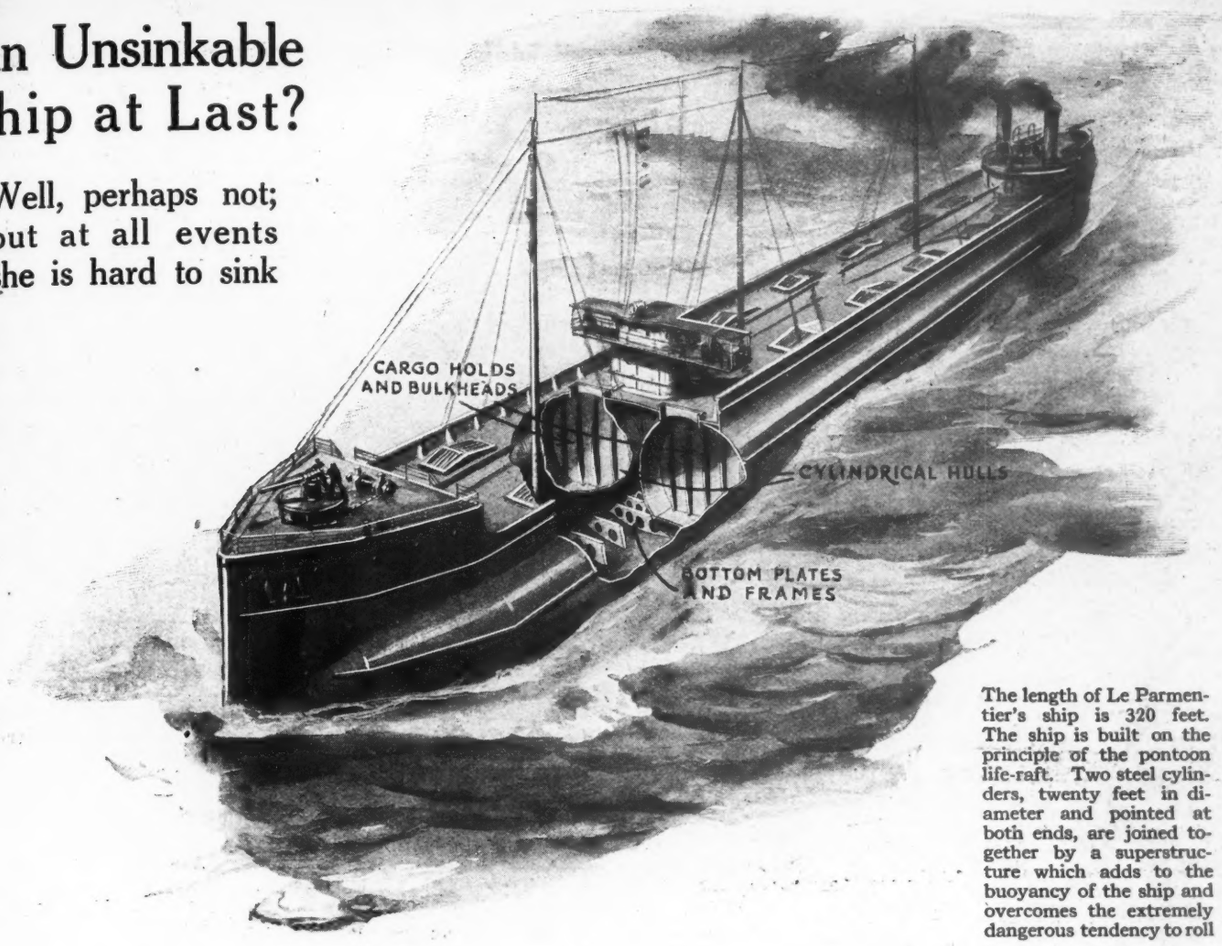
A lively baby is perhaps the most difficult subject the photographer tackles. This one put the moving-picture men's skill to a real test

The youngster entered thoroughly into the spirit of the thing, gesturing so amusingly at the camera battery that onlookers applauded.

The cameramen confessed that "photographing the baby," even with modern improvements, is still a task for the expert.

An Unsinkable Ship at Last?

Well, perhaps not; but at all events she is hard to sink



The length of Le Parmentier's ship is 320 feet. The ship is built on the principle of the pontoon life-raft. Two steel cylinders, twenty feet in diameter and pointed at both ends, are joined together by a superstructure which adds to the buoyancy of the ship and overcomes the extremely dangerous tendency to roll

UNSINKABLE ships are undoubtedly possible in theory; but, in spite of all efforts, it has not been possible so far to translate them into actual fact. They belong to that class of much desired things which includes perpetual motion, frictionless bearings, fast dyes, and a perfect substitute for rubber. The wholesale destruction of ships in the present war has greatly stimulated the desire for unsinkable ships, and the naval architects of all countries have concentrated their ingenuity upon the problem of evolving some such type.

At last human ingenuity seems to have succeeded in inventing a type of ship that, if not absolutely unsinkable, is as nearly so as it is possible to make it. This ship is the invention of the noted French naval engineer Le Permentier, who for years before the war conducted experiments relating to the stability of floating bodies.

When the German submarine peril became acute, the French government gave Le Permentier every assistance in carrying out his experiments. The type of boat invented by him was tried off the French coast, and the tests were so satisfactory that the French government decided to have a number of that type of ship built. A contract for five of these ships was awarded to an American shipbuilding corporation, and the first completed ship of the new type is to be delivered next April.

Not a New Principle

Le Permentier's ship is based upon the same principle as the pontoon life-raft, which is by no means new. Two steel cylinders, twenty feet in diameter and pointed at both ends, are joined together by a superstructure which adds to the buoyancy of the ship and overcomes the dangerous tendency of any cylindrical body floating on the water to roll.

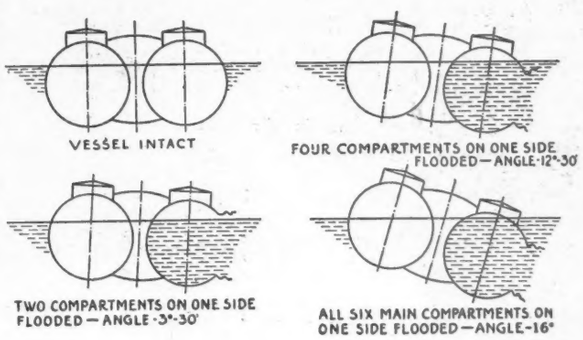
The length of the ship is 320 feet over all, and the two pontoon cylinders are nearly that long. They are joined together by transverse members, covered with plating at top and bottom to provide a narrow central watertight compartment. This compartment may be used for storing oil.

Each pontoon as well as the connecting central part of the hull, is divided by transverse bulkheads into six watertight compartments, making eighteen such compartments in all. The ship is equipped with two independent steam power plants. The two power plants occupy the stern compartments of the two pontoons. The cargo is to be carried in the compartments of the pontoons.

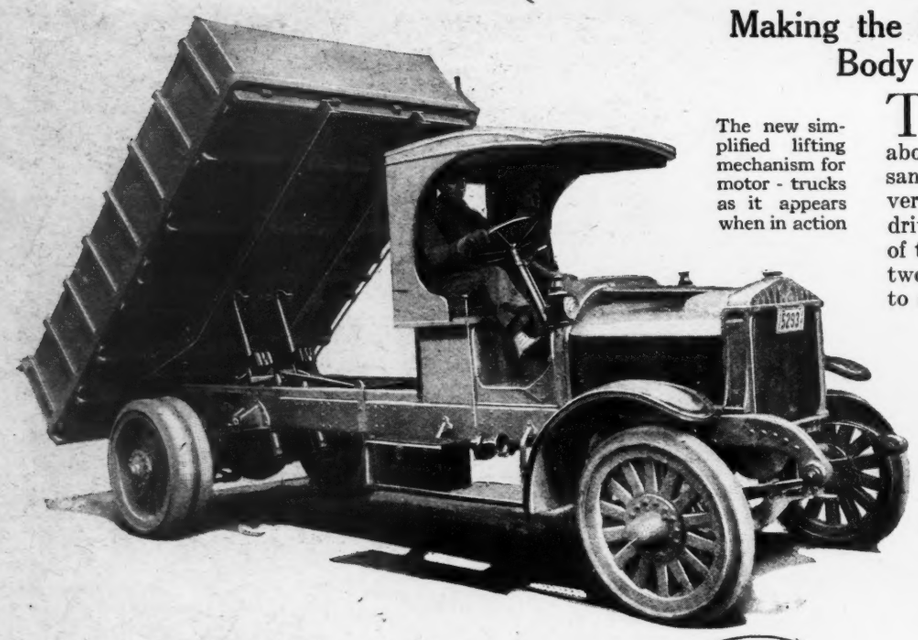
Its Chances Against Submarines

The ship is expected to have a capacity of at least 4,250 tons, with a sixteen-foot draft. The estimated speed, when fully loaded, is eight knots—which, while slow, is considered sufficient in view of the unsinkable character of the ship. The gun crew could make a submarine submerge by gunfire before it had an opportunity to fire more than one or two torpedoes.

The tests conducted by the French government indicate that, even if all compartments on one side were flooded, the ship would still remain afloat.


VESSEL INTACT
FOUR COMPARTMENTS ON ONE SIDE FLOODED—ANGLE-12°-30'
TWO COMPARTMENTS ON ONE SIDE FLOODED—ANGLE-3°-30'
ALL SIX MAIN COMPARTMENTS ON ONE SIDE FLOODED—ANGLE-16°

Making the Engine Dump the Truck Body in a New Way



The new simplified lifting mechanism for motor - trucks as it appears when in action

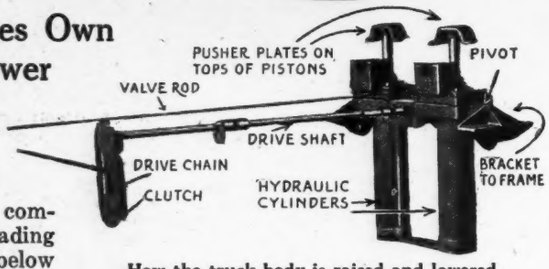
THE next time you see a big motor-truck with its body elevated above the rear end to dump a load of sand, stone, or asphalt, note the vertical cylinder directly back of the driver's seat. You will see coming out of the top of the cylinder a rod having two pulleys with ropes running down to some point on the body itself. Oil is pumped into and out of the cylinder through pipes by power from the motor-truck engine to raise and lower a piston inside of the cylinder and thus lift the body up and then let it down by gravity. The body clears the driver's seat by about two feet.

To utilize this space, and to eliminate the oil pipes, which sometimes leak, a hoist has been devised which raises the body from the bottom instead of from the front. The hoist gives a direct lift; is cheaper by half than the average hoist; and permits the converting of any box-body truck into a dumping body.

Self-Loading Truck Saves Own Time and Man Power

IN these days when motor-trucks are playing such an important rôle in the transportation of the nation's goods, and when it is so difficult to obtain competent truck-drivers, the self-loading commercial vehicle illustrated below points a way to efficiency. This particular truck is employed to haul cut stone. Whereas it formerly took an hour to load six tons, the mechanical hoist has reduced this to twenty minutes.

The mechanical loading and unloading means consists of a horizontal I-beam extending lengthways of the truck about six feet above the floor. The lifting of the load is accomplished by a differential block and fall capable of raising two tons by pulling on the chain with one hand.



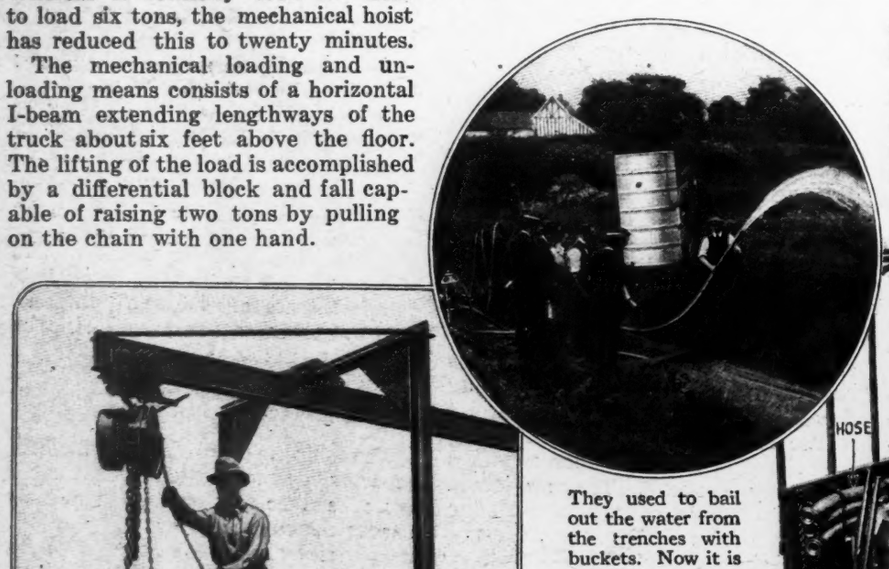
How the truck body is raised and lowered

Between two pivoted cylinders is a gear-pump. Oil forced into the cylinders raises the pistons and then lifts the truck body. The pump is driven by the truck engine

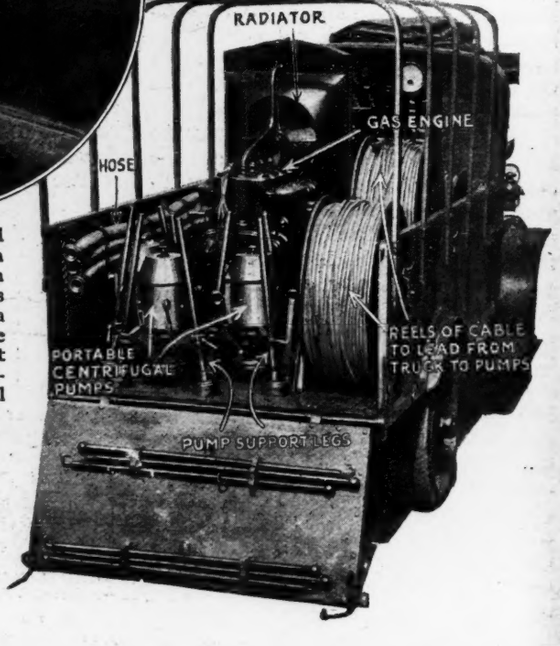
Trucks to Pump Out Trenches

MEN in the trenches have made a feeble effort to save themselves from rheumatism and pneumonia by bailing out the water with buckets. The British army is now employing trucks to pump out the flooded trenches.

The new apparatus consists of a 32-horsepower, four-cylinder gasoline motor mounted in the body of a motor-truck, and connected to a dynamo furnishing current by flexible cables to three motor-centrifugal pumps.



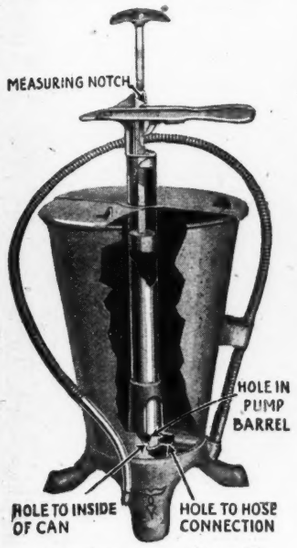
They used to bail out the water from the trenches with buckets. Now it is pumped out by a motor-truck. The picture on the right shows the apparatus in detail



The mechanical hoist makes it possible to load six tons on to this truck body from the ground in twenty minutes

This Grease Will Not Soil Your Hands

A NEW bucket-pump for lubricating oil has been invented and patented by Ira A. Weaver, of Springfield, Ill. It consists of a metal bucket, conical in shape, with a tight fitting cover. A pump-cylinder fits through an opening in the center of the cover, and extends down to and through the bottom of the bucket.



A bucket pump that will discharge the lubricant just where it is needed

To the upper end of the pump-barrel a lever is attached by means of which the cylinder may be turned so that the oil contained in the space of the bucket surrounding the pump may be drawn into the pump-cylinder by the suction of the piston.

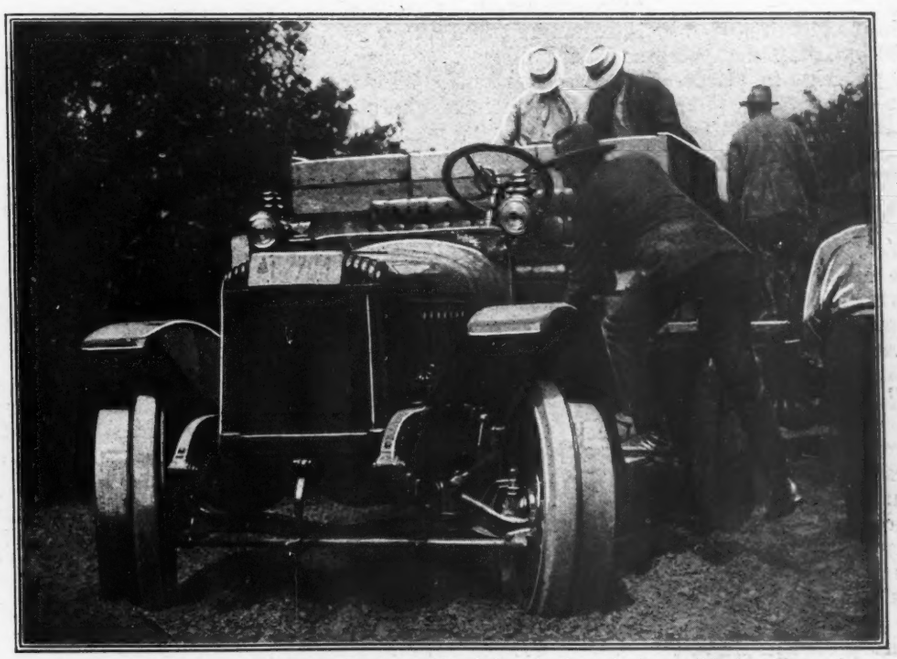
When the cylinder is turned into the opposite direction the opening connecting it with the bucket is closed and another hole opened, through which, when the piston is depressed, the oil contained in the cylinder is discharged through the nozzle of the discharge tube.

An Attachment for Driving a Truck Over Soft Ground

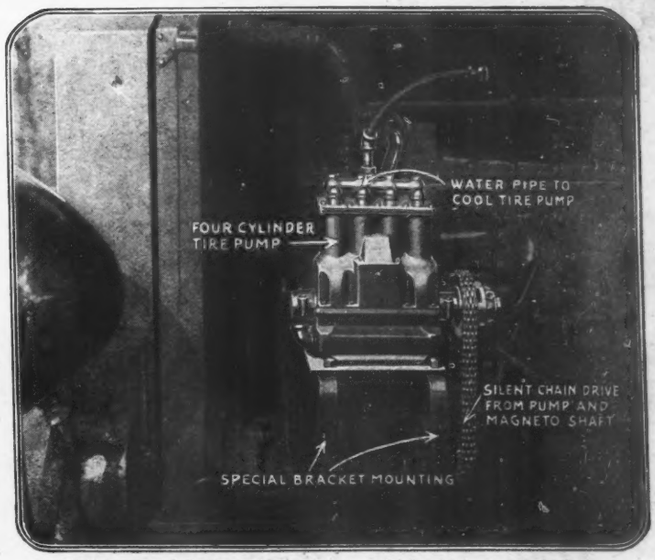
AN entirely new attachment for the motor-truck has made its appearance out in Los Angeles, Cal. It is a heavy steel flange, to be attached to the outer side of the various wheels of the car, which makes it possible to use the truck on the soft ground of an orchard, grain-field, or even vegetable patch. The flange does not interfere with the operation of the vehicle on the hard-surfaced roads.

The flange wheel is made of very heavy steel, two inches in thickness and six in width, extending outward from the felloe of each wheel and being fastened securely in place. When run from the hard street into the orchard the hard tires sink into the soft earth until the flanges become engaged, when the machine runs along in the manner of the wide-wheeled tractor.

Another good point that holds promise for the rancher is that this new method of hauling does away with a great deal of the jar to which the fruit heretofore has been subjected.



Heavy steel flanges attached to the outer side of the wheels make it possible for this truck to move over soft ground; they do not interfere with progress on hard-surfaced roads


WATER PIPE TO COOL TIRE PUMP
FOUR CYLINDER TIRE PUMP
SILENT CHAIN DRIVE FROM PUMP AND MAGNETO SHAFT
SPECIAL BRACKET MOUNTING

This four-cylinder tire pump, which is mounted in a convenient position under the engine bonnet, solves the problem of inflating the giant-sized tires on big motor-trucks

Convenient Engine Pump for Trucks with Pneumatic Tires

WITH the increasing use of giant-size pneumatic tires on trucks up to five tons in capacity has come the problem of fitting some sort of pump on the trucks, so that the tires can be inflated on the spot, even if miles away from the nearest garage.

The big tires cost as much as two hundred dollars, and it would be suicidal to try to run a truck of such size with a flat tire. The need for such a pump has been greater on trucks running in the open country than those operating within city limits, because the number of garages along any route is naturally much smaller between towns than in a city proper.

While many of the pumps on passenger cars are placed underneath the body and driven off the gear-set, it is necessary in a truck to have it where the driver can get at it conveniently.

Accordingly, one of the four-cylinder types used on the five-ton trucks which are operated overland by one of the big tire companies in the city of Akron is mounted under the engine bonnet and driven off the pump and magneto shaft by means of a silent chain, like that shown in the illustration at the top of this page.

A pump of this kind will easily inflate the biggest truck tire to a pressure of more than a hundred pounds to the square inch in the space of two or three minutes.

Photograph from the Yerkes Observatory

When sunspots are numerous, we also observe an excessive number of "prominences." These are red flames of hydrogen, which may shoot up at a speed of two hundred miles a second to a height of hundreds of thousands of miles

Blame It on the Sunspot

Solar upheavals that make mischief on earth

THAT favorite scapegoat, the War, was not responsible for all the abnormal events of the memorable year 1917, and the German spy, as a versatile mischief-maker, has a rival who is none the less formidable because his base of operations is 93,000,000 miles away from the nearest munition plant.

Let us go back in imagination to the 9th of August, 1917. Last night you may have taken pleasure in watching the ghostly streamers of a fine auroral display shift and shoot in the northern sky. Your morning paper tells you that telegraph lines all over the country were paralyzed by "earth currents" of extraordinary intensity. There were, in fact, hours together when not a single message could be sent by wire anywhere in the United States—an event without precedent in the history of American telegraphy.

Cause Still a Mystery

Torrents of natural electricity, sweeping through the earth, swamped the relatively feeble currents by means of which the circuit of a telegraph line is completed underground. At the same time, compass needles everywhere behaved as if bewitched, oscillating back and forth, to the bewilderment of mariners whose faith is pinned on them.

The more delicate magnetic needles installed at observatories underwent even more pronounced disturbances. In short, a violent magnetic storm was in progress.

What is the meaning of these uncanny events? After breakfast you seek out your friend the Professor, to inquire whether the end of the world is at hand. The Professor happens to be an astronomer. By way of answering your question he hands you a pair of colored spectacles and bids you take a look at the sun. Right in the middle of the solar disk you notice a rather conspicuous fly-speck.

Now you enter the observatory. The astronomer opens a long slit in the dome, revolves the latter until the sunshine streams through, takes the cap from the tube of his telescope, sets the driving-clock in motion, and swings the instrument around until a magnified image of the sun falls upon a white screen attached below the eyepiece. Thus enlarged, the fly-speck turns out to be a cluster of ragged black spots with gray borders.

"We are now," says the Professor, "in the midst of a period of remarkble solar activity, of which sunspots are one of the symptoms, though by no means the only one. The Sunday Supplement will undoubtedly tell you that the aurora of last night, the earth currents, and the magnetic storm were 'caused' by the large group of sunspots which you see near the center of the sun; but it would be nearer the truth to say that, while all these things are intimately connected with one another, the ultimate cause is still a mystery.

"Astronomers have learned that the sun passes through periods of perturbation, or storminess, which recur on an average every eleven years, and that certain terrestrial phenomena tend to run through a similar cycle.

The Sun's Periodic Variations

"Our sunspot records show the eleven-year period unmistakably, although it is by no means a regular one, and a great many minor fluctuations are superimposed upon the general curve of 'spottedness.' A few years ago there were days and weeks together when not a single sunspot could be seen. Now it is not uncommon to see a hundred at a time.

"That sunspots denote a state of disturbance in the solar atmosphere is shown, first of all, by the fact that when spots are numerous we also observe an excessive number of the discharges known as *prominences*. These are the red flames which may be seen along the edge of the solar disk during a total eclipse. While some promi-

nences are seen to hang quietly over the same place for several days, others shoot upward at a speed of from one to two hundred miles a second to a height of thousands and even hundreds of thousands of miles.

"Measurements made with the pyrheliometer of the amount of solar heat received by the earth show that the sun is hottest when spots are most abundant, although very delicate observations have shown that a spot is itself a relatively cool part of the sun's surface. Lastly, there is a marked difference in the amount of electricity which the sun gives forth at different times. Like all hot bodies, the sun discharges a host of electric corpuscles, or electrons. It is probably the bombardment of our atmosphere by these corpuscles that causes the aurora. Striking the rarefied gases of the upper air, they illuminate them, as an electric discharge lights up a vacuum tube.

Photographing the Sun

"Now let us look at a photograph of a sunspot. Here is one made at the Mount Wilson Solar Observatory. The spot has the appearance of a great hole opening into the sun's interior. Around the black center, which we call the *umbra*, is a broad border, or *penumbra*, which might be compared to a grating of bright bars with dark spaces between them. The bright shell in which these spots appear, called the *photosphere*, is a layer of incandescent clouds, consisting of metals and other substances, floating in an atmosphere of the same substances in a state of gas, and having a temperature of between 6,000 and 7,000 degrees centigrade (about twice that of the electric furnace).

"Even though we think of sunspots as holes torn in the solar clouds, their appearance through the telescope or in an ordinary photograph hardly suggests the idea of violent motion. This is much better brought out in photographs taken with an instrument called the *spectroheliograph*, an invention of Dr. George Ellery Hale.

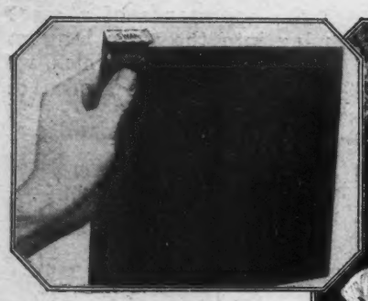
From a drawing by Scriven Bolton in the *Illustrated London News*

Sunspots are holes in the solar clouds. A sunspot is a whirlpool which sucks in the light, overlying hydrogen. Because it is a tornado in violent revolution, a sunspot produces the same magnetic effect that we get from a current flowing through the coil of an electromagnet. The electrical and magnetic effects of the sun on the earth are of far-reaching importance. Curiously enough, we are likely to have our coolest weather on the earth when the sun is most active, and therefore at its hottest

How the Sun Affects Our Weather

"The final proof that a sunspot is a whirlwind or tornado in the solar atmosphere was furnished just ten years ago. Assuming that the electrons discharged by the sun are caught in the whirl around a spot, their revolution should produce the same magnetic effect which we get from the electric current flowing through the coil of an electromagnet. A sunspot should, therefore, be intensely magnetic. Laboratory experiments have proved that when light passes near a magnet it shows, when examined with the spectroscope, a splitting up of the spectral lines, known as the 'Zeeman effect.' In 1908, Hale, at Mount Wilson, tested the light from a sunspot for this, and found it at once.

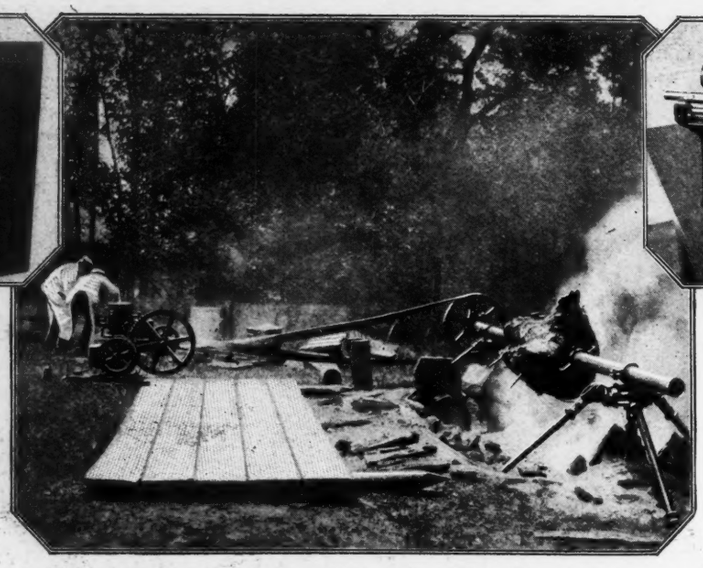
"Will the study of the sun help us predict the weather? Probably it will; but at present nothing more definite is in prospect than predictions of the general character of entire years and seasons over broad areas of the earth. For more detailed predictions we can get no help from the sun until we know just why there are twice as many spots on the sun today as there were a month ago, and just how many there will be by the middle of next week. When we can predict the sun's weather, we shall have taken a long step toward predicting weather.



A Convenient New Label-Holder

MUCH of the inconvenience that results from label-holders standing in a vertical position can be eliminated by the use of a holder that stands at an angle.

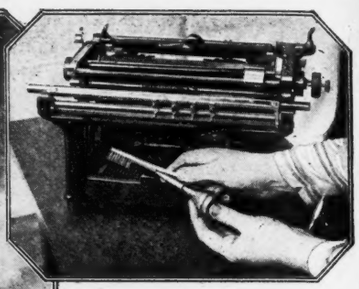
The label is held in the best position to catch the eye and to be read with ease; at the same time it is firmly fixed in position, and so compact as not to occupy valuable space and be cumbersome. The holder is readily attached to papers and holders, and is all metal.



Turning the Barbecue Ox with a Gasoline Engine

BARBECUES at which oxen are roasted whole ought to become more popular than ever, now that an ingenious method has been perfected that turns the carcass for hours with the regularity of clockwork, permitting the meat to cook deliciously enough to please any connoisseur. The idea was successfully carried out at a barbecue held in the woods on Grand Island, near the southern shore of Lake Superior. A four-inch pipe sixteen feet long, two drill tripods, a twenty-eight-inch split wooden pulley attached to one end of the pipe, a belt, and a gasoline engine—such was the carcass-turning equipment.

The two-horsepower gasoline engine was set to turn the ox about four times a minute. The ox was cooked over a trench twelve feet long and three feet deep.



A Typewriter Brush with Self-Oiler

IT is easy to keep your typewriter in apple-pie order with the aid of the brush shown in the photograph above.

Attached to the handle of this brush is a small oil-can, from which oil can be forced directly into the bristles. The oiled bristles then pick up the dust from the various parts on contact.

The brush has the additional advantage of enabling the typist to keep her machine in good condition without in the least soiling her hands.

Anyone an Expert Signaler Now

THE bluejacket snapping his flags about so briskly from the bridge of a battleship, the mystic movements of the semaphore or the swift interchange of messages by pennant need no longer puzzle the landsman. An alert publishing house has put on the market a device by means of which anyone can quickly become an expert at reading code, wigwag, or Véry system signals.

It consists of a pocket-size cardboard chart with four revolving faces that display the various flags and other signals through slits as the faces are turned about. On the face of the chart are printed, in the proper colors, the keys to the signals.

Holding the card in one hand, you can send yourself messages and record them with the other until the eye has been trained to translate instantly the meaning of the signals.

The Modern Way to Plant Poles

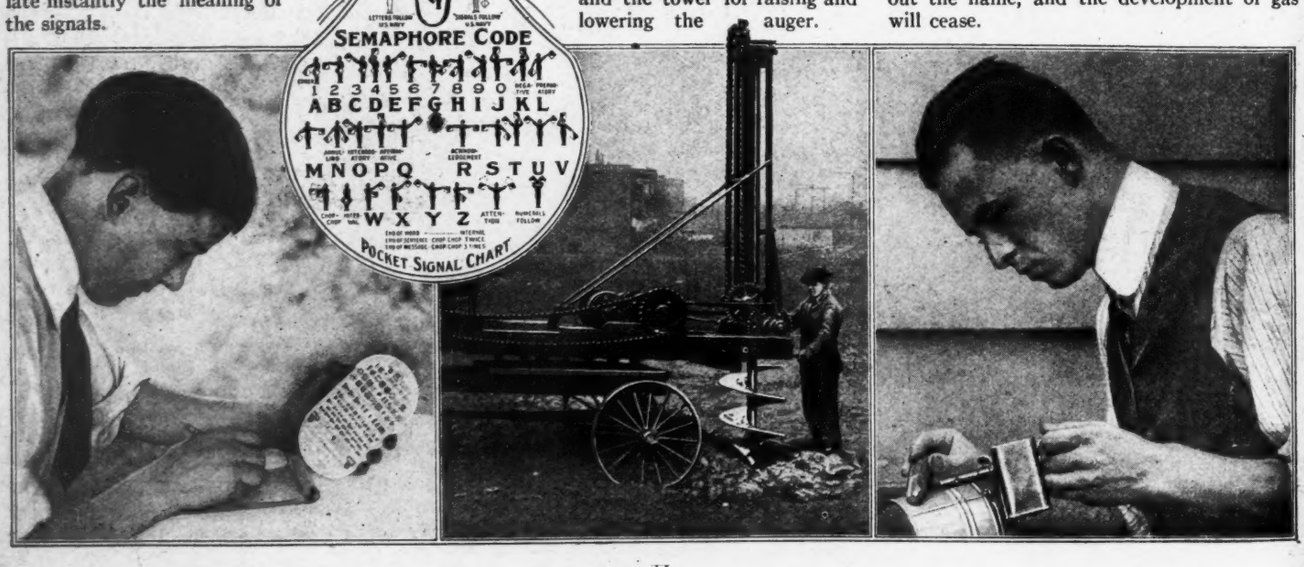
DIGGING holes and setting up telegraph or telephone poles by man power is slow work, and besides man power is becoming scarce and costly. But new telegraph and telephone lines must be established. The problem seems to have been solved by a labor-saving machine which has been tried out in building a telephone line across Nevada and Utah and has given remarkably good results. Two men with this machine can plant one hundred poles a day.

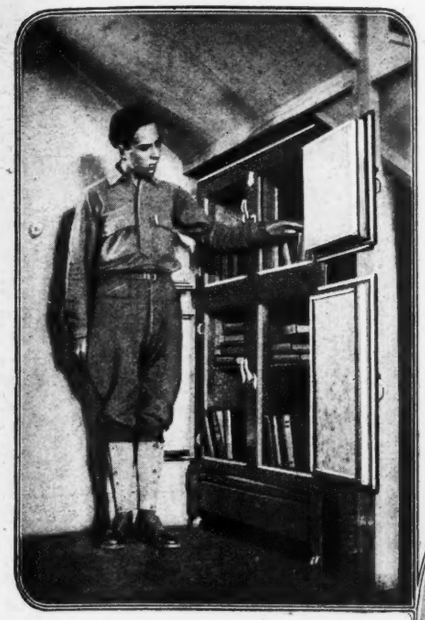
The boring machinery is mounted upon a steel roller-bearing hub truck which has a weight-carrying capacity of 10,500 pounds. It consists of a turntable, five by twelve feet, on which is mounted the boring mechanism and the tower for raising and lowering the auger.

Here Is a Handy Blow-Torch

THIS useful pocket torch, which can be used in joining telephone, electric light, or broken current wires of any description, consists of a small metal tank, two by three inches in size, made at a small cost and designed to burn alcohol as fuel.

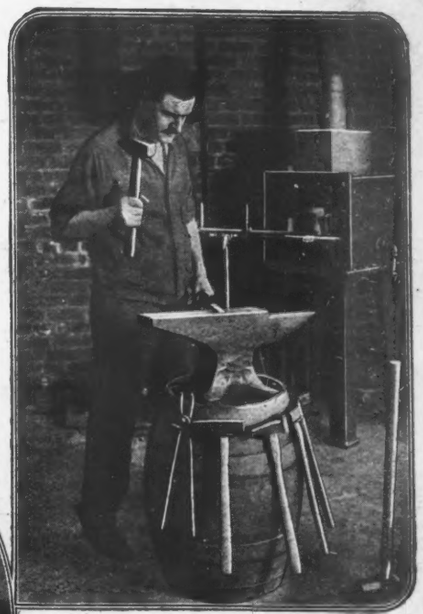
The tank is wholly or partly filled with alcohol, which is absorbed by the packing contained in the tank, and then by the wick. If a flame is applied to the outer tube, the outer and inner tubes will immediately warm up, and will cause the fluid in the inner tube to change into gas. As this gas develops in a larger degree than the size of the opening in the metal plug will allow it to escape, a certain amount of pressure is produced by which the gas escapes and continues to create new gases. Should more gas develop than can be burned by the flame, this gas will blow out the flame, and the development of gas will cease.





Making Life Easier for the Shine Boy

THE young man in the picture below found this shoe-shining stand very convenient. Before the boss bought it for him he had to lug all the shoes that the hotel guests left outside their doors at night down to the basement and back again. But this stand is light and is equipped with wheels, so that the shoe-shine boy can wheel it to a convenient nook on the same floor, and do his night's work in half the time it used to take.



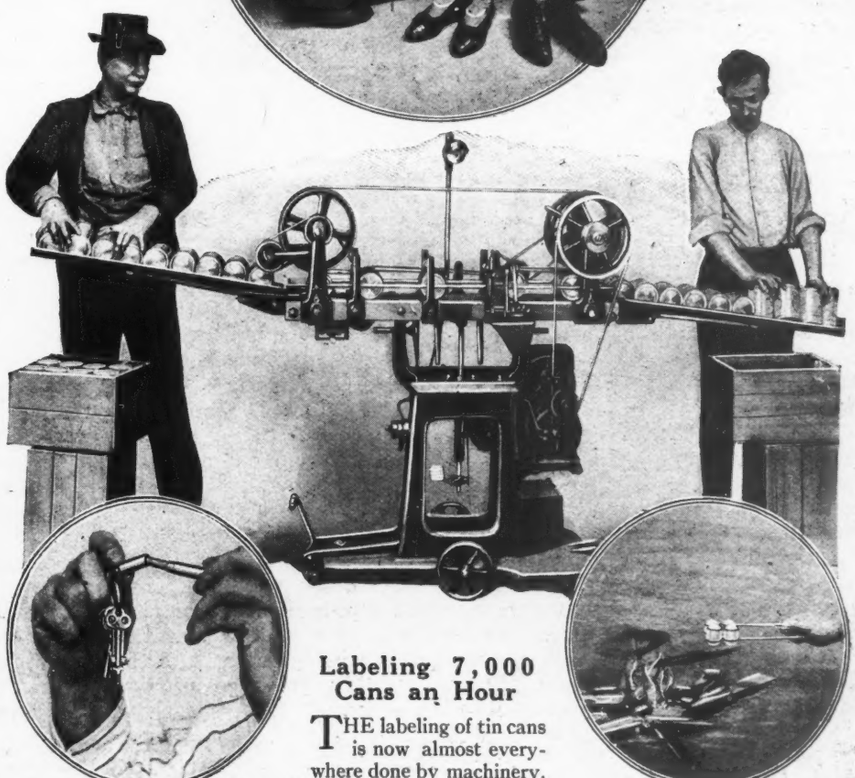
© Publishers' Photo Service

The Refrigerated Library

YANKEE ingenuity might be defined as "making something do for something else" if it didn't lay us open to the charge of being a race of substitutors; but the ability to make use of the apparently useless is not to be sneezed at. Moreover, it has been put to the test by the war, and has survived the test.

At the Camp Funston General Hospital the problem was, what to do with an ice-box for which no ice could be obtained, and how to care for several dozen volumes, sent to the soldiers by the American Library Association, when there was no lumber with which to build bookcases.

Just there Yankee ingenuity stepped in: the useless ice-box became a bookcase, and the shelves which were intended for ice, butter, and pork chops, were called upon to support poetry, novels, and trigonometry.



A Beer-Keg Anvil-Stand

THEY have pretty largely taken the beer out of industry now, but that's no reason why the old keg should not remain, as the blacksmith in the picture above has shown by using a beer-keg as an anvil-stand.

He filled the keg with sand, which made it heavy enough to be steady, yet did not make it too heavy to move about as need might require. The collar about the top of the keg—which is not at all to be confused with the collar on the beer—serves to hold the anvil rigid without any other fastener, and so it is easy to remove the anvil at any time.

The keg, being round, offers no obstruction to the blacksmith as he moves about his anvil, and with a few large staples he can very easily make a handy rack to hold his tools.

Labeling 7,000 Cans an Hour

THE labeling of tin cans is now almost everywhere done by machinery. A modern labeling machine like that shown in the picture above, if worked by hand power, will label from 40,000 to 50,000 cans in ten hours. A machine driven by steam or electric power averages from 60,000 to 70,000 cans in ten hours.

The machines are built of iron, steel, bronze, and brass, and automatically fasten the labels upon the cans with waterproof cement, which hardens at once, so that the labeled cans can be packed immediately after coming from the labeling machine. Some of the machines are made for one definite size of cans, while others can be adjusted to cans of different sizes.

To Outwit the Pickpocket

THE haunting fear of being held up and left penniless out in a strange world is done away with by a little device so small that it may be carried on the key-ring, where no self-respecting hold-up man would think of looking. It has a capacity of one reserve bill.

The bill, whether a one or a hundred, when closely rolled, fits into the barrel of the holder. A man who has lost his keys might become excited if the holder contained a thousand-dollar bill, but the average citizen can use the device safely enough.

A Roaster for the Camper

COOKING eggs in hot coals or ashes often meets with disaster, but the difficulty disappears when the device here shown is used. The holder has a capacity of four eggs, though of course one, two, or three may be cooked. The eggs may be held over the coals, or placed in the ashes or coals in the holder, to be withdrawn when cooked. They are easily inserted, and held firmly in place.

The holder may also be used for bread-toasting, baking apples, potatoes, and the like, either in the open or over a stove.

Not content with riding to the fishing-pool, this sportsman also makes his motorcycle do the fishing

Harness the Reel to Your Motorcycle

IF you like surf fishing with a hand-line, you may be interested in the invention of John J. O'Connor, a Californian who is a lover of surf fishing besides being a motorcycle enthusiast.

Watch Mr. O'Connor at his favorite sport. A strong pull at the line. A bite!

Mr. O'Connor fastens the shore end of his line to a spool or reel bolted to the hub of the fly-wheel of the motorcycle that he rides when he goes fishing. A turn of the fly-wheel starts the engine, and quickly the line is reeled in until the fish appears on the surface of the water. Then the engine is shut off, and the exciting hauling in of the fish is done by hand.

No cut and burned fingers, no tangled lines. The reeling in is accomplished in shorter time than it could be by hand, and without discomfort.

All that is necessary is to remove the nut that holds the fly-wheel and then to attach the reel. This change can be made in a very few seconds.

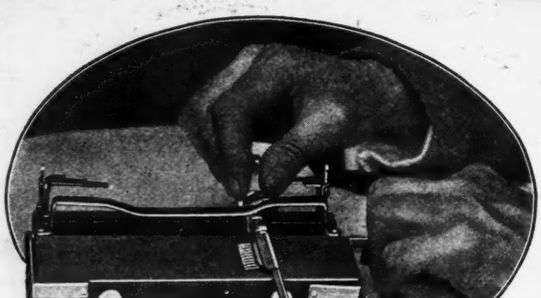
Your Safety Blades Can Be Honed

RAZORS, particularly the old-fashioned kind, must be honed and stropped from time to time, to keep them in good condition. A device that has been put on the market recently by a Western manufacturing concern makes the honing and stropping of safety blades, as well as of the old-fashioned razors, extraordinarily easy.

The blade, placed in an auxiliary holder, is slipped in a carrier holder, which is pressed down against a slide-bar with even pressure by an elastic strip of metal. The cylindrical handle of the carrier holder runs through a hole in the carrier block, and is given a half turn at each end of the stroke by tripping-pins, which are brought in contact with the trippers at each end of a stroke as the carrier block, with the blade-holder, is slid forward and back in a groove. The blade slides over the stone edge first. For honing the blade, the position of the blade is reversed.

The blade is held against the stone or the stropping leather at the same angle and with the same pressure at all times, which insures a uniform bevel, and consequently a perfect edge. With this device a dozen blades of a safety razor can be kept in serviceable condition for years.

This, of course, means greater economy for the steadily growing army of safety-razor users.



By pushing this handle back and forth, even a small child can hone and strop a razor blade

Now that baseball is presented in capsule form, American "fans" can be happy anywhere

A Pocket Edition of the Great American Game

A POCKET-SIZE baseball game, which is said to have a great vogue among United States soldiers and sailors, consists of three important baseball positions: "at the bat," represented by a white dial, subdivided into the different hits and runs; "the field," an inner ring of green, with alternate squares labeled "safe" or "out"; and "the umpire," occupying the center space which is divided into "out strike" and "safe hit." The player at the bat is naturally pitted against the player in the field.

The player at the bat spins the pointer, an arrow-shaped needle whirling on a button in the center of the circular spaces. If the pointer stops at the first-, second-, or third-base hit or home run, a man is put on base. If the pointer stops at a strike, one strike is counted against the man at the bat, and so on.

The center space, representing the umpire, is used whenever any argument arises.

A larger edition of the game is provided with three separate dials, each with its own needle or pointer.

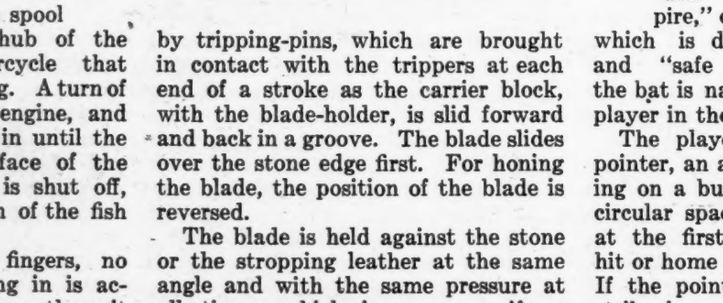
A Combination Rack and Triangle for Pool-Players

AN improvement for amusement places where pool is played is a combination wall rack and triangle which does away with handling the balls when they are to be returned to the table at the end of the game, and which makes unnecessary the triangular rack for assembling them.

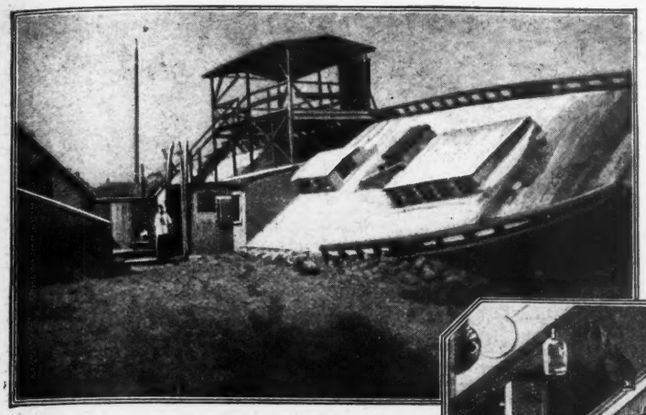
The wall rack is made in two sections, which, forming a triangle by means of a third piece across the base, spread apart.

By a single movement the balls may be taken from the wall, placed on the pool-table, and assembled.

The rack has five compartments for as many players.



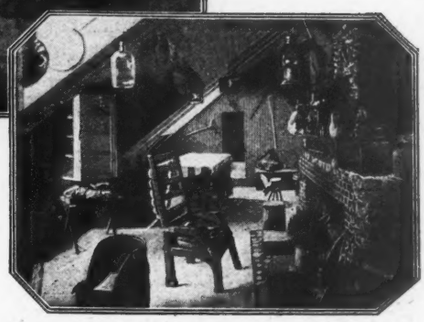
When the sections are spread apart in this fashion the pool balls roll out on the table in the proper position for five players



After demolishing a fisherman's cottage on the Massachusetts coast, this boat was allowed to stay on the beach and was turned into an interesting house.

A Wrecked Pilot-Boat Turned into a Dwelling

ABOUT nineteen years ago a large pilot-boat was wrecked off the coast of Scituate, Mass. A mighty wave lifted it and dashed it high up on the beach, where it crashed into a fisherman's cottage. The cottage was splintered, but the boat was only smashed in on one side. What remained of it was purchased by Otis Barker, a resident of Scituate, who converted it into a home of such great interest that it is one of the "show" places of the vicinity.

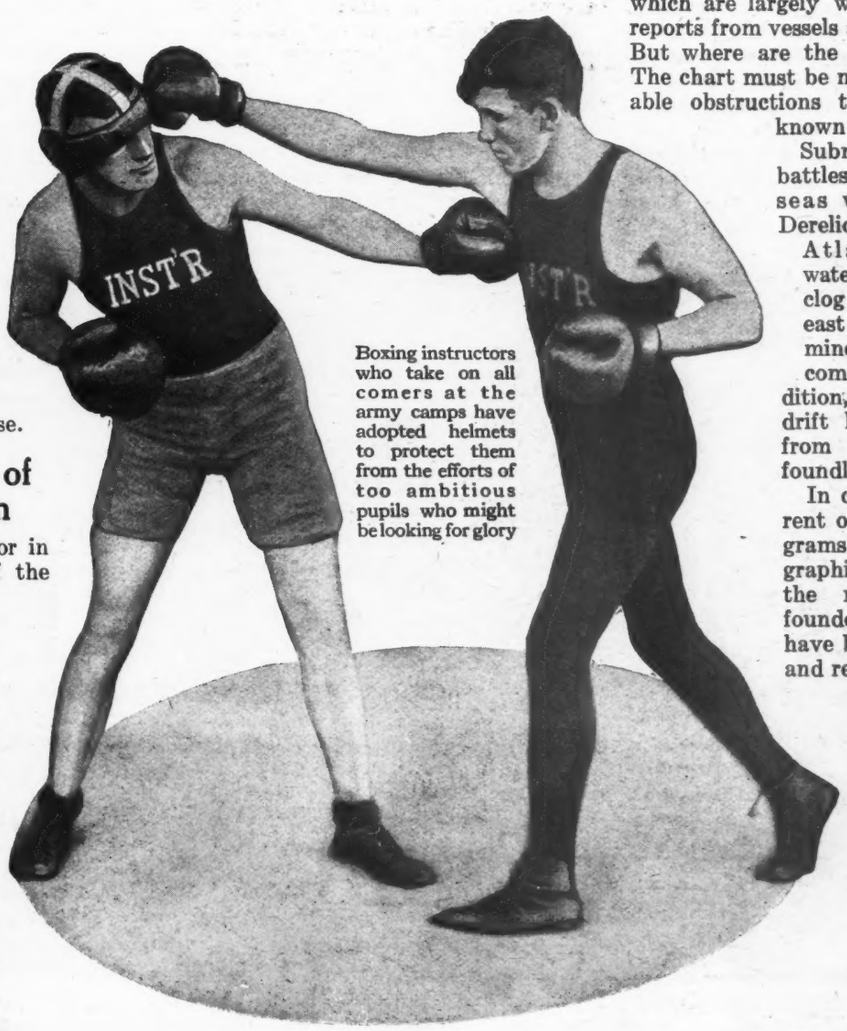


In the living-room is a friendly fireplace built of field stones. In the center of it hangs a swinging crane. On the shelf above the hearth an inscription from Dickens has been burned in: "Glad to see you. You will find us rough, but you will find us ready."

Comfort is the keynote of the interior. At the bow of the boat is a small den, which opens into the living-room. All around the living-room are bunks made from sea-chest. On one side of the fireplace is an old armchair made from the remains of Daniel Webster's boat, at the stern is another little den, containing a bunk, a small writing-desk, and a book-case.

A Mere Matter of Self-Protection

BEING an instructor in boxing at one of the army cantonments, with some thousands of husky young Americans taking delight in slipping in an unexpected blow, is at times not the pleasantest job in the world. Hence the boxing helmet shown in the photograph. The helmet affords complete protection to the ears, nose, and eyes, reducing to a minimum the amount of damage done when some pupil lands hard.



Boxing instructors who take on all comers at the army camps have adopted helmets to protect them from the efforts of too ambitious pupils who might be looking for glory

Vigia: Being the Newest War Horror

BEFORE the war a captain off soundings — in other words, well clear of the land and in deep water — was free from anxiety. Today he threads his way with fearful caution between a swarm of "possible dangers."

More nerve-racking than any U-boat is his new war horror — the "vigia."

The Hydrographic Office of the Navy issues "Notices to Mariners" in leaflet form, which are largely warnings based on reports from vessels all over the world. But where are the dangerous spots? The chart must be marked. Questionable obstructions to navigation are known as "vigias."

Sometimes the lookout sees what may be only the ghost of a dangerous derelict, but he reports his suspicions, and then another "vigia" goes on the chart

Submarines and naval battles have strewn the seas with wreckage. Derelicts dot the North Atlantic. Hulks of water-logged schooners clog every trade route, east or west. Drifting mines and buoys are common sights. In addition, summer icebergs drift like gray shadows from the north Newfoundland current.

In consequence, a torrent of letters and telegrams floods the Hydrographic Office. Many of the reports are well founded. But sailormen have become "panicky," and readily call a blotch of oil a submarine.

But the Office cannot discriminate. If there is a germ of truth in the report, it must be distributed to the entire Navy and merchant marine. Next day a thousand navigators plaster another "vigia" on their charts.

Better Stop! Look! and Listen!

IT has been suggested that a universal danger sign be adopted—one that will be recognized immediately by any person of any nationality, irrespective of his ability to read the language of the country. In addition, it could be associated with a graphic illustration of the danger to be avoided.

The design put forward is that of a square, set on its corner diamond fashion, with diagonals supporting a circle or ball. The square would be painted white, and the ball red.

Experiments have been made with colors to ascertain their visibility in poor lights. The result of this was that white was found to be far the best, yellow being next, but requiring about three times as much illumination as white. Red is away down at the bottom of the list, along with blue and black.

To educate people in the use of the new sign, it has been suggested that for a limited time notices in the form shown in our illustration should be used, the warning being translated into various foreign languages.

A proposed new sign that gives a most graphic illustration of the danger

Here's a Marine Railway Portage

How river boats scale a thirty-foot levee

WHEN the thirty-foot levee along the banks of the Illinois river, below Peoria, Ill., was built to protect about fourteen thousand acres of farm-land from periodic floods, the connection that had existed between the river and Spring Lake, thirty miles from Peoria, was cut off. But the courts decided that the connection between the lake and the river must be maintained. A canal with lifting locks would have been too expensive to build and to maintain; hence it was decided to adopt the marine railway plan.

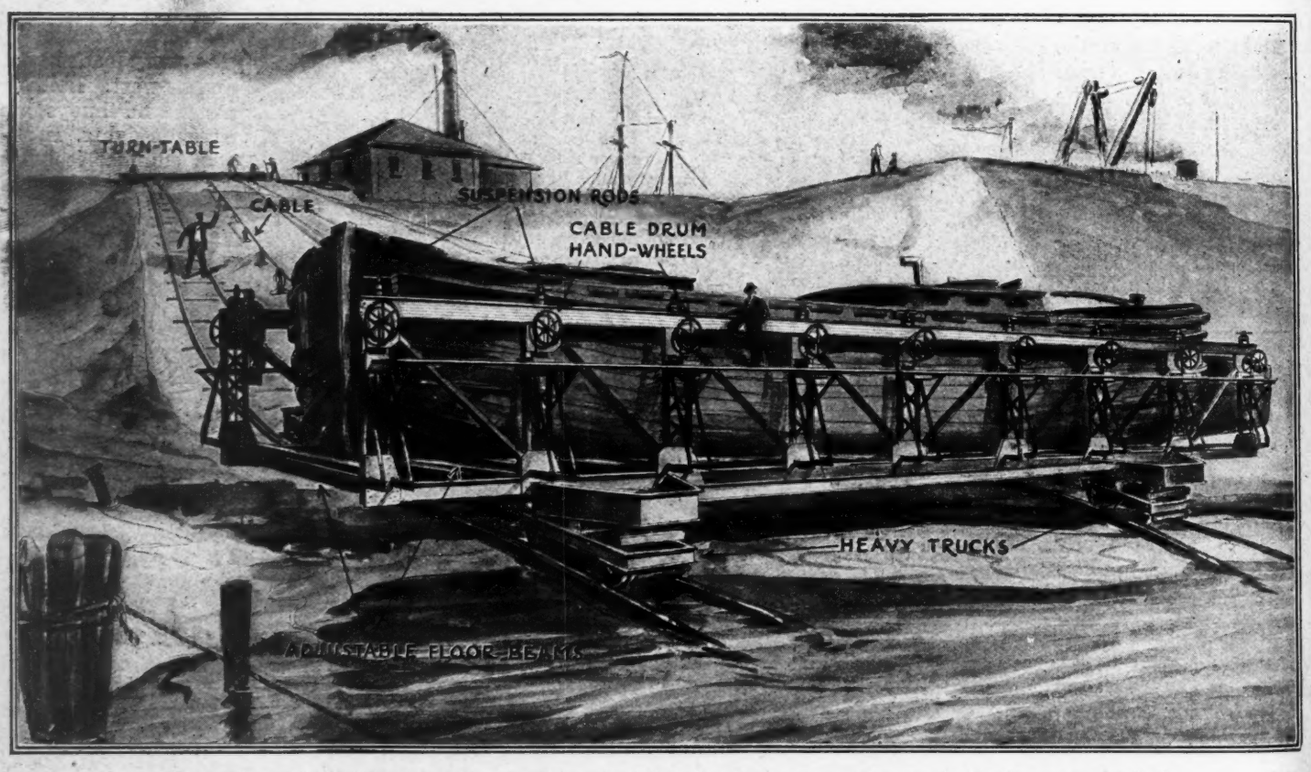
An incline of ten per cent grade and 295 feet long leads from the river to the top of the levee. The incline leading from that point down to the lake forms a horizontal angle of about 135 degrees with the river incline. It has a ten per cent grade and a length of 305 feet. The change in the direction of the two inclines made it necessary to build a turntable, which swings the boat from one incline to the other.

Each incline has two standard-gage tracks. The lower ends of the inclines are submerged to a sufficient depth for the floating of the boats as they enter or leave the cradle.

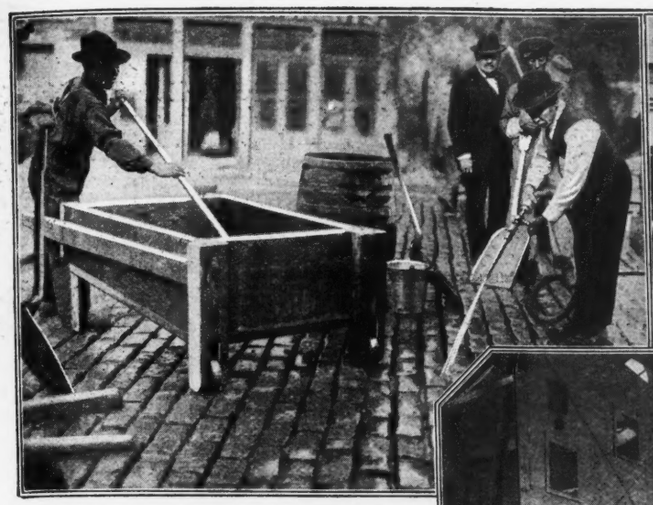
The boat-cradle has two vertical longitudinal trusses 80 feet long and 10 feet high. These are connected by floor beams and diagonal bracings underneath them. Adjustable floor beams form a deck which carries the boat over the inclines.

When a boat is floated into the cradle and over the submerged floor, the boat beams are first raised by the hand-wheels operating the cable drums. Then split nuts fitted with handles are clamped on the threaded rods, and are turned by hand so as to bring the beams to a firm bearing against the hull, thus taking the load.

The boat carriage is manipulated by means of a 1½-in. steel cable. Upon reaching the top of the incline the cradle is transferred to the turntable, which is pivoted between the two inclines.



The cradle—which with a heavy boat weighs about four hundred tons—moves up the incline at a speed of sixteen feet a minute. A spring, released by the sudden slackening of the cable, sets the brakes on the wheels



Flushing the pavement blocks preparatory to filling in with a mixture of cement and sand

Making Over Old City Pavements into New

THE municipal government of Cincinnati has found a way to make new streets out of old ones, thereby saving fully two thirds of the cost.

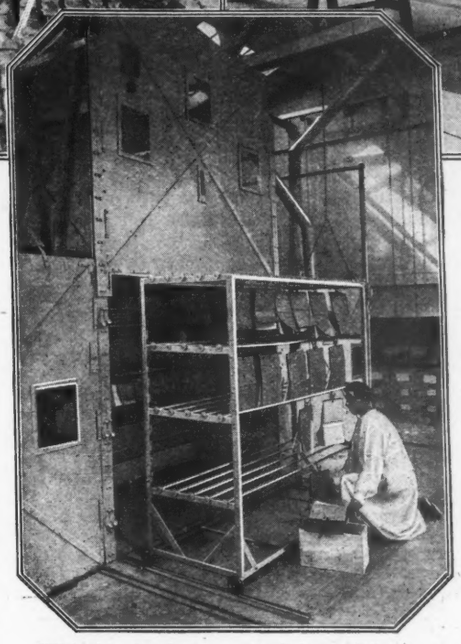
When granite pavement begins to show holes and ruts, the entire paving is torn up, and the layer of sand beneath it is removed. In nine cases out of ten the concrete foundation of the street will be found in first-class condition. A level sand surface bed for the granite is then prepared on the old concrete foundation. The old sand is used for that purpose, and only as much new sand as is necessary.

The old granite blocks are scraped clean of tar or other binder, and are then relaid on the new sand bed, half-inch spaces being allowed between the blocks. They are then thoroughly flushed with water.

Then, while the paving is still wet, a thin mixture of two parts of sand to one of cement, with enough water to make it flow readily, is raked over the surface, taking care to fill every crevice. While this surface is still wet, a thinner mixture of equal parts of sand, cement, and water is raked over it. It is allowed to set for several days; then the street is ready for traffic.

This surface of cement not only remains smooth after years of wear, but does not become slippery in the winter-time or after a drenching rain in summer.

The price of a made-over pavement is about one third what a new one would cost.



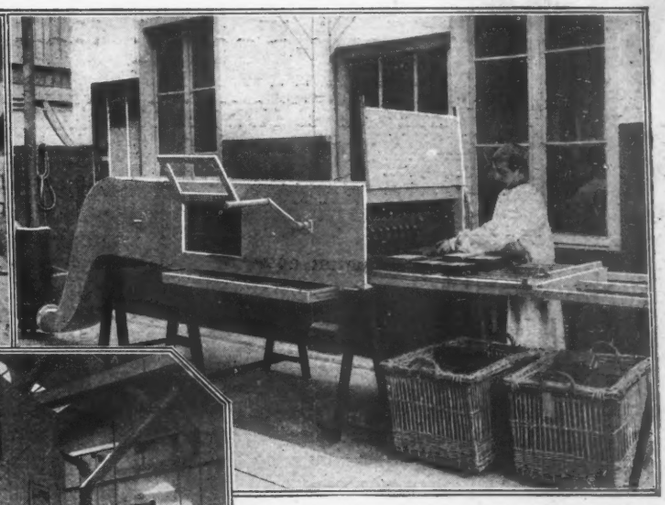
With this simple apparatus it is possible to sterilize books without injury to them, and with perfect safety to the operator

The photographer can focus with the assurance that no sagging of the cloth will obscure the lens

To Restrain the Frivolous Focusing-Cloth

IT has taken amateur photographers thirty years to produce a man—Edward W. Humbert, of Uniontown, Pa.—sufficiently annoyed with the focusing-cloth to patent a method that will make it shield the camera it formerly pulled over.

The reformed cloth is of the ordinary material, and rectangular. It has, however, near the forward end and in the center, an opening of sufficient size to let the lens and its mounting protrude. This opening is equipped with eyelets corresponding with the usual projections of the front-board of a camera, to hold the cloth in position.



In the "beater," wooden rods turned by a handle strike the books, releasing the dust

Gassing the Germs in Books

ALMOST the first thing to meet the eyes of French hygienists in their war-time campaign for protecting the younger generation was their old enemy, the circulating book, well known as a carrier of disease. The many obvious solutions of the problem shared one disadvantage: while killing the germs they destroyed the book also.

For the method perfected by Dr. Marsoulan, and now practised in the Institute for Wounded and Infirm Workmen at Montreuil, it is claimed that for one fourth of a cent for each book, and with safety to operators, books can be sterilized without the slightest injury. Two pieces of very simple apparatus are used: a beater and a disinfector.

The beater is a long box open at one end and communicating at the other with an ordinary stove. Inside of the beater are wooden rods so arranged that the turning of a handle will cause them to strike on the books placed on a sliding frame. As the rods beat the books, the heavier particles of dust fall out into a tray of disinfectant below, and the lighter are carried by an exhaust fan to a stove, where they are burnt.

The books are hung, open, by spring clips from a skeleton framework, and wheeled into the disinfecting chamber, which is equipped with a tank containing a solution of formaldehyde. The temperature is raised to 120° F., the formaldehyde kills the germs, and the fumes are carried off by a funnel.

Treating Four-Footed Patients In a Hospital

By A. M. Jungmann

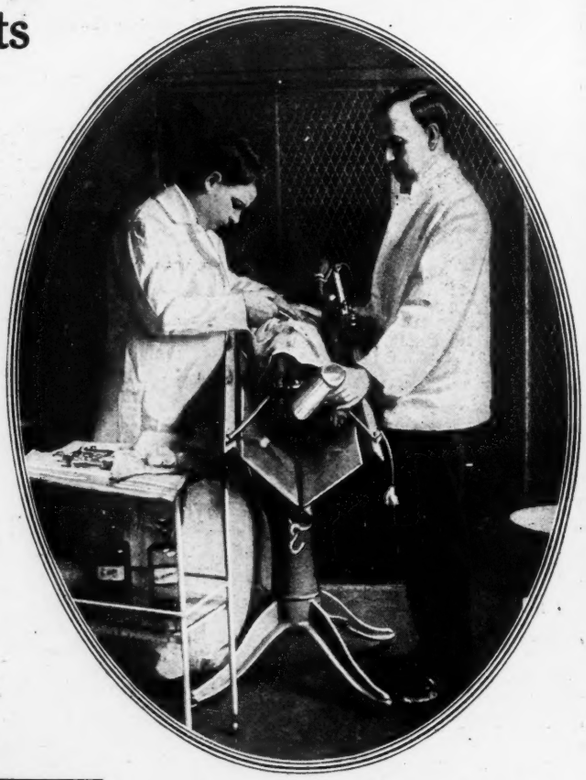
IF you had a favorite horse that broke its leg, would you shudder and cover your ears while someone put a bullet through its brain? Or, if your horse is sick, would you try to "doctor" it yourself as best you could? Neither the finishing bullet nor unskilled doctoring are necessary. Nowadays, if your horse has an accident or gets sick, you can call an ambulance, just as you would for a member of your family, and send it to one of the excellent hospitals that are equipped and maintained for the benefit of animals. And that applies to cats and dogs, too.

Women's League for Animals Hospital

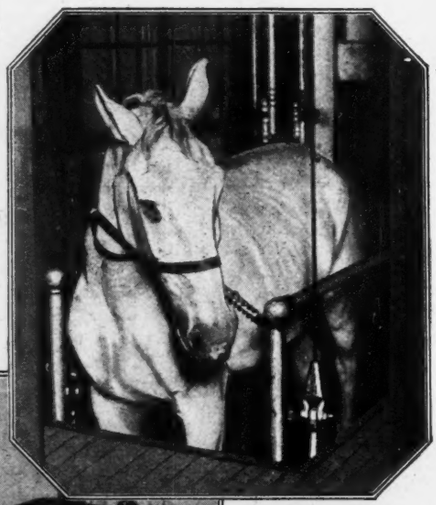
The New York Women's League for Animals has a splendid hospital where patients receive the very best treatment. The hospital is divided into wards and operating-rooms for large and small animals. A sick horse is brought into a reception-room in an ambulance, placed on an elevator, and taken to the ward or operating-room, as its case may demand. The animal is moved so skilfully that it neither struggles nor suffers unnecessary pain. The horse wards are clean and sunny and free from flies.

Some of the ailments of horses are treated by means of baths. If your horse needs a medicated bath, it is placed on a platform, a kind of trap-door, and lowered into the bath. This arrangement is desirable because the horse does not have to exert itself by stepping up or down in order to enter its bath, and it does not get frightened.

Suppose your horse has been injured. It is placed in an arrangement of bars, somewhat like a stall, and tied in such a manner that it is fairly comfortable; yet it cannot move and harm itself while the doctor is dressing its wounds. This ingenious apparatus is known as the "stocks." A receptacle for antiseptics is hung above the stocks, and a rubber irrigating-tube is connected with the receptacle.



A new operating table for small animals. It is adjustable and may be made to accommodate any size animal. Doctors Bruce Blair and R. H. Spalding are performing an operation on a spaniel at the hospital maintained by the New York Women's League for Animals



This horse is being lowered into a bath. The platform is raised and lowered like an elevator

The stocks in which horses are placed to have their wounds dressed. Note the antiseptic container and rubber tube connected to it, which comes just behind the doctor's head. This enables him to irrigate the wound with an antiseptic solution

Horses suffering from painful wounds are always given an anesthetic before being operated upon. The operating-room looks very much like the operating-room in a hospital for human beings.

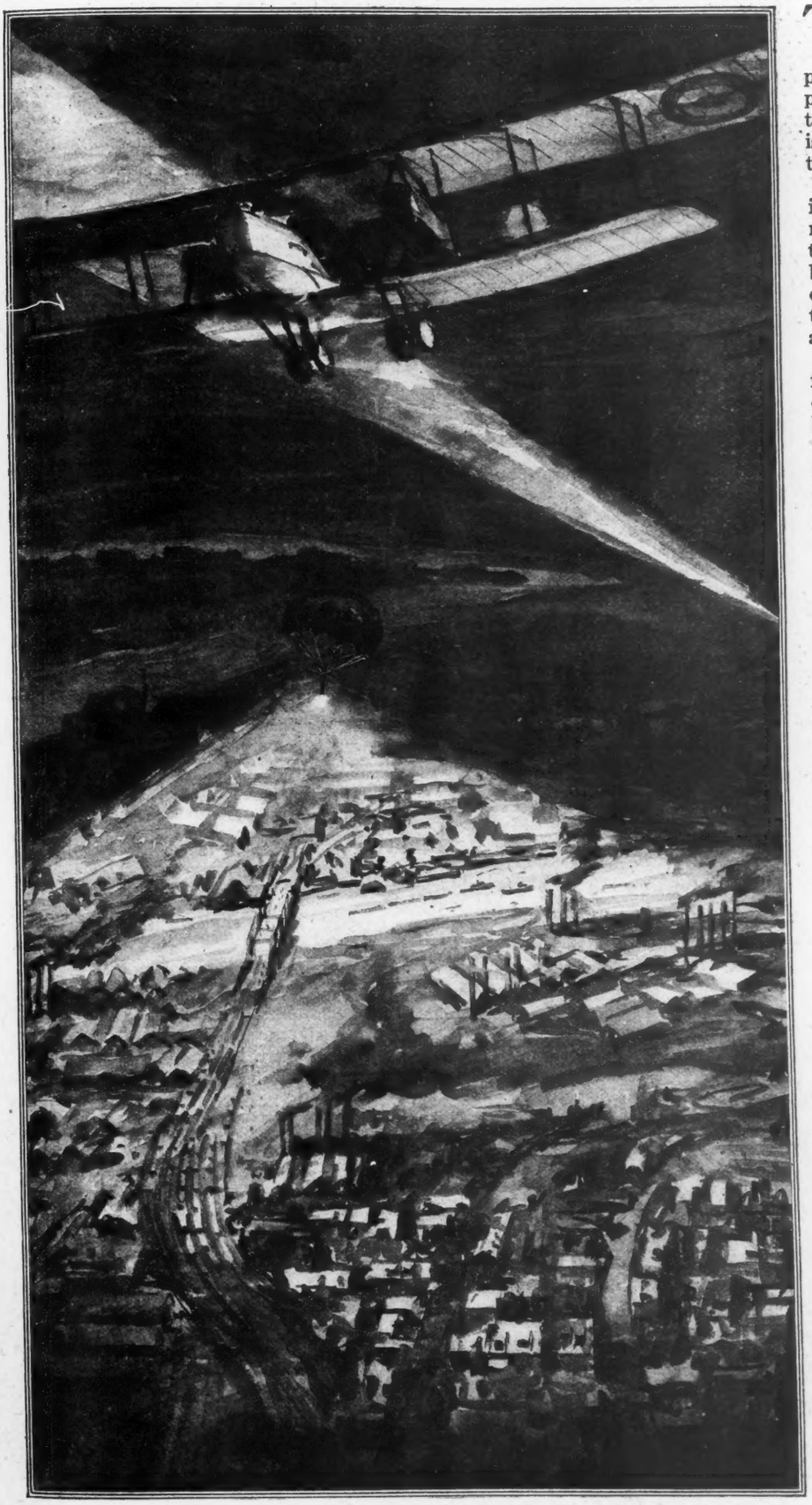
A feature of this room is a new operating-table which was recently presented to the League. It is adjustable so that any small animal can be placed on it in such a manner that the surgeon can do his work rapidly and efficiently. It is pivoted on a stand, so that it will rotate in any direction, and is divided down the center and adjustable to any angle.

A Dog with Nervous Prostration

All kinds of patients are received at the clinic of this hospital. The waiting-room will frequently contain several cats and dogs, sometimes a parrot or a canary bird, occasionally a monkey, squirrel, or other unusual pet. Perhaps the most unusual of all the cases recently treated there was that of a dog suffering from nervous prostration. Its mistress had kept it in a small New York apartment, and had ruined its digestion with bonbons, until its canine system had broken down.

The Airplane Flare—To Light the Enemy's Country

By Albert Whiting Fox



The parachute holds the brilliant light in suspension from four to eight minutes, while the aviator locates his objectives and drops his bombs

THE new airplane flare, which the Bureau of Ordnance of the War Department has perfected, is destined to play an important part in the offensive operations which American air-craft is to undertake against selected targets in German territory.

The flare—which is mounted in a red tin can about a yard long, resembling in appearance a miniature Zeppelin or torpedo—hangs below the airplane by a framework of metal straps. It weighs about thirty pounds, and is released by a lever.

As the flare starts downward from the airplane, the resistance offered by the air causes a small brass wheel mounted at one end to revolve, which in turn sets the mechanism in motion, while at the same time the parachute is opened by air pressure very much like the old-style circus balloon.

Suspended by a Parachute

This parachute holds the flare suspended in the air, while the mechanism causes the emission of a powerful light of from 300,000 to 350,000 candle-power. Tests already conducted show that this light completely illuminates the terrain below.

The parachute holds the brilliant light in suspension from four to eight minutes, in which time the aviator locates his objectives, drops his bombs, and proceeds on his way.

The power of the light is about equal to that supplied by a battery of from 150 to 175 street arc lamps. If we could suspend, say, fifty incandescent lamp-bulbs over a darkened German city and let the light go down, it would help some. This flare is equal to hanging from 15,000 to 17,500 incandescent lamp-bulbs over the selected point of attack.

The use of pyrotechnics in war is for the twofold purpose of signaling and illumination.

Before the United States entered the war, the Bureau of Ordnance had perfected signaling and illuminating devices of its own; but when it was decided to brigade our troops with the French, it was necessary to have only one set of signals for all. General Pershing therefore ordered all pyrotechnics to be made to conform to the French system.

The devices of a pyrotechnical nature include cartridges, rockets, smoke-bombs, caterpillers, flares, and position lights.

The Bomb-Droppers and How They Work

Great birds, laden with death-dealing bombs, carry terror far back of the German lines

By Carlyle F. Straub

The author of this article is a young American who enlisted in the Royal Air Force and became acquainted with the activities of the Handley-Page bombing airplane.—The Editor

The giant Handley-Page biplane was built chiefly to drop bombs on important strategic centers that lie far behind the enemy's lines. It must fly by night; for it is too slow and too unwieldy to elude fast enemy single-seated fighters

British Official Photograph; © Underwood & Underwood

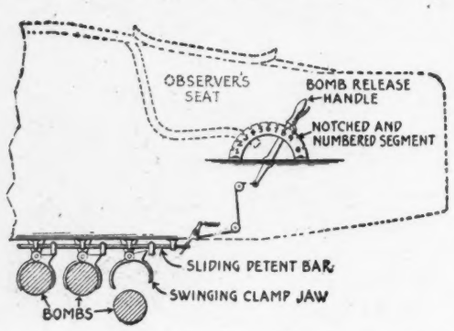
BEFORE the war only a few imaginative journalists believed in dropping bombs on fortifications. To be sure, the General Staffs of the European Powers made experiments with dropped bombs, but that was chiefly to confirm their view that it was almost impossible to hit a target on the ground from an airplane moving at high speed several thousand feet above the ground. Both the journalists and the General Staffs proved to be right when the test of war came. Bombs can be terribly effective—but targets are undeniably hard to hit. For all that, bombs are dropped more and more frequently.

Bombing activity has increased many hundred per cent since the war began. A record of raids made by airmen of the Allies over German supply centers is available only for the six months beginning January 1 and ending June 30, 1918. Here it is:

	No. of times Raided
Bensdorf—Station and sidings	6
Coblenz—Station and barracks	3
Cologne—Stations, factories, barracks	3
Courcelles—Station and sidings	8
Diedenhofen (Thionville)—Station and sidings	19
Esch—Station and sidings	3
Hagendingen—Railways and factories	3
Karlsruhe—Station and workshops	4
Karthaus—Station and bridges	7
Kreuzwald—Electric power station	9
Landau—Barracks, station, sidings, gasworks	9
Mannheim—Chemical factory	12
Metz—Station and sidings	20
Metz-Sablons—Stations, sidings, railway triangle	25
Saarbrucken—Factories, sidings, station	6
Spittel—Station	2

Development of Bomb-Dropping

The development of bomb-dropping in the four years of the war has been so rapid that it seems almost incredible as we look back upon it. Both the Germans and the French were so busy watching each other's movements with the aid of aircraft, in the anxious days that preceded the first battle of the Marne, that there was no time for bomb-dropping. And when at last the two forces dug themselves in and the systematic use of airplanes began, the bomb appeared. At first artillery shells were dropped by venturesome volunteers on the side of the Allies. It was not until 1915 that



Details of the machinery that releases at a touch the bombs, weighing 100 pounds each, carried by the giant planes

the bomb, as we know it, was introduced, and then it was by Germans in their attacks on open towns.

Before bombs can be effectively dropped you must have a machine by which they can be carried. The bombs must be as heavy as possible; they must be as numerous as possible. Hence a bombing-machine must be, above all, a weight-carrier. But a machine that carries a heavy load cannot be fast; nor can it climb high or maneuver easily. It becomes a prey to the speedy enemy fighter. To meet that situation bombing-machines were designed along the lines of two-seated reconnaissance airplanes which could carry a few light bombs. They had but a small radius of action, and accordingly they were used only for attacking ammunition dumps, batteries, and railway junctions in the battle area.

But back of the enemy's lines—a hundred miles, perhaps—are important ammunition factories, stores, railway centers, and great depots. These are of strategic significance. To reach them with the light, fast bomber, is almost hopeless. A still heavier machine is required. Such a machine cannot be successfully used in the daytime. It would become an easy mark for attacking enemy planes and for anti-aircraft guns—because it is too slow, too large. Hence it flies by night, so that it has chiefly the anti-aircraft batteries to contend with.

First Big Bombs English

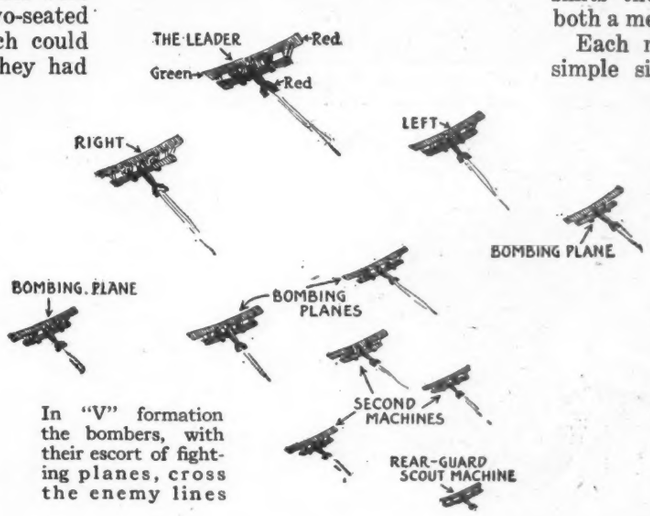
The first of these huge long-distance bombing-planes was unquestionably the Handley-Page of England. As soon as it fell into the hands of the Germans it served as a model for the Gothas, Friedrichshafens, and A. E. G's.—machines which have bombarded London and Paris time and time again. The Handley-Page has been pictured and described so often that it is hardly necessary to dilate upon her hugeness again. The wing span is never less than ninety-eight feet, and may even be as much as a hundred and ten; the fuselage, or body, is sixty-five feet long.

The number of bombs carried varies with circumstances. The average load is six bombs of one hundred pounds each. A bombing journey in a Handley-Page lasts from five to nine hours.

The Night-Birds and How They Fly

A bombing raid is as carefully planned as if it were a scientific expedition. For days reconnaissance machines have studied the particular railway center or battery that is to be blown off the map. Hundreds of photographs are taken of it.

Finally the eventful night comes. It is midnight. A dozen machines are lined up—huge, curious, gaunt night-birds. At the tail-end of each glows a red light. It serves as a warning to the man behind: there must be no rear-end collisions. You can identify the commander's machine, because it has a green light on one wing-tip and a red light on the other, like a ship.



In "V" formation the bombers, with their escort of fighting planes, cross the enemy lines

The commander climbs into the cockpit. There is a splutter and a roar. He is off. In a few seconds he is followed by a pair of fast fighters—guarding escorts. Then the other machines rise, followed by more escorting fighters. The machines fly in "V" formation.

Forty miles behind the German lines, the squadron sees powerful lights that mark the railway center to be destroyed. The searchlights are those of an anti-aircraft battery. Now, the beam of a searchlight is a straight line, but the path of an anti-aircraft projectile is curved. The commander dives straight down into the light, knowing that he cannot be hit. The German knows it too. He shifts the beam. Thus the light is both a menace and a protection.

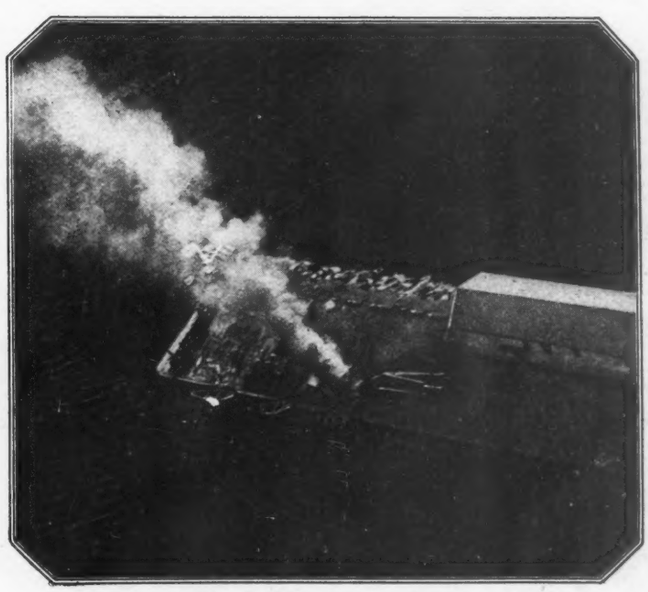
Each machine is equipped with a simple sighting apparatus—as simple as the sights of a rifle. Each observer notes the speed of his machine and its height from the ground. He adjusts the sights accordingly. He pulls a trigger or handle. One bomb is released. He waits—ten, twenty, thirty, forty seconds. There is a red flash far below. The searchlight is literally blotted out. The battery has surely been hit. The formation continues its flight. Faint lights can be seen below; they travel in a very definite course. What are they? A line of motor transports. Some of the lights suddenly vanish. The motors have run to cover.

Was the Raid Successful?

This is the depot to be blown up. The commander dives. The rest of the squadron imitate him, opening out as it does so. Then follows a hail of death. Over an area of twenty miles fires can be seen flaring up. Surely the railway center must be destroyed. The leader banks his machine—the signal to begin the flight for home.

Was the raid successful? To find out, a reconnaissance machine equipped with cameras is sent over the German lines the following day. It brings back a score of pictures.

Here is a hole in a pasture; there an anti-aircraft gun overturned; in a ditch lies a motor-truck. But the depot is still intact. Another expedition must be organized. And so, night after night, for two and even three weeks, the squadron must vault into the air, drop its freight of death, and return, until the photographs bear unmistakable witness of the center's complete destruction.



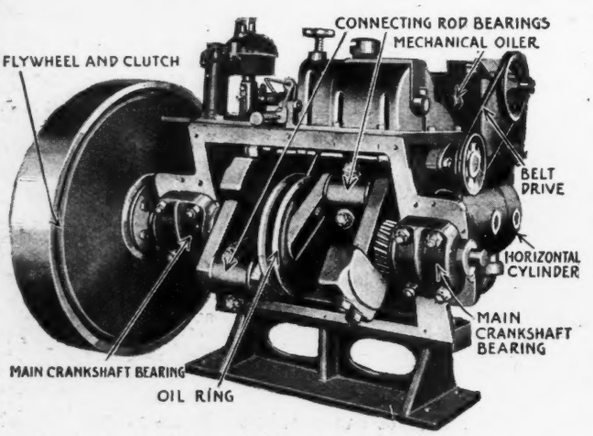
The end of a perfect raid. Bombs have fallen squarely on the mole in a German harbor

Running a cultivator is not so very strenuous if you can sit comfortably, shaded by a parasol, on a big three-wheeled tractor, and watch the work being done for you

A Tractor with Three Wheels

BECAUSE approximately 100,000 farm tractors will be manufactured in the United States this year, the farm tractor industry is fast bringing us to the motorized farm, with motor-cars to carry the farmer in his work, motor-trucks to deliver his goods, and now the motor farm tractor to plant, cultivate, and cut his crops.

With this development in the industry, which last year made only twenty thousand tractors, has come a great change in the design of the tractors themselves. Briefly, the tendency in design has been toward the light machine, equipped with an automobile-type gas engine and following automobile practice throughout in power transmission, steering, and other details of construction. One of the newest and most advanced types of tractors to be seen in the fields this year is shown in the accompanying illustration. This tractor has many unusual features, including three wheels, an enclosed gear-set, and a frame to prevent the machine from tipping.



The driving mechanism of the new tractor embodies many novel features

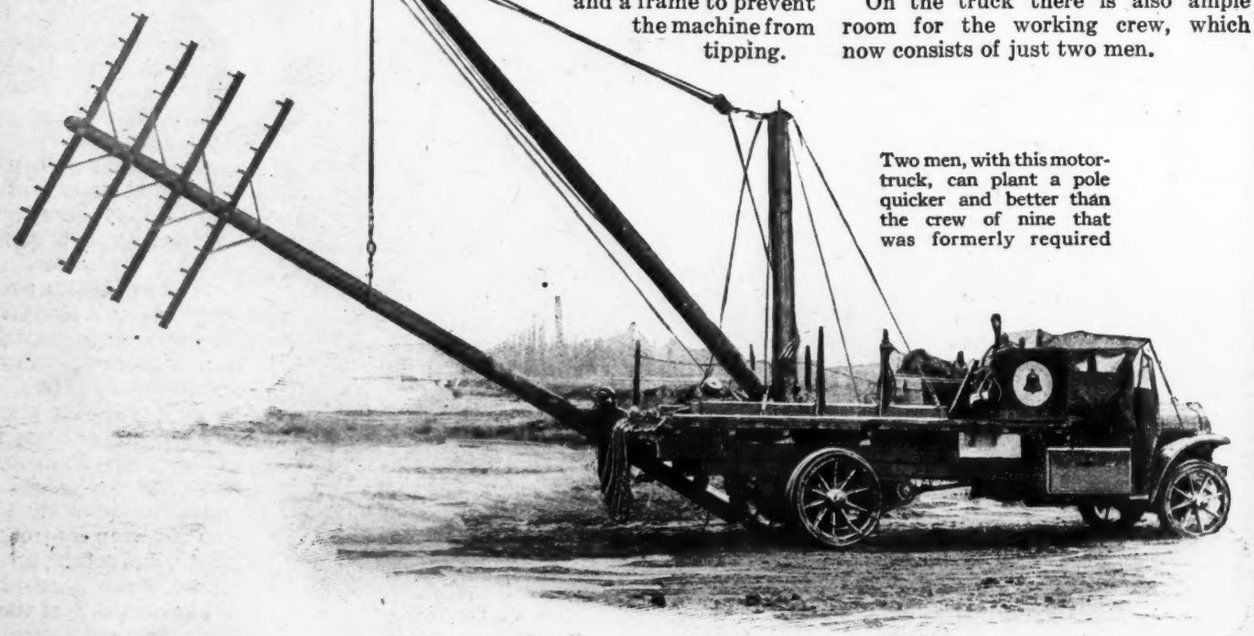
Motor-Trucks Revolutionize Telephone Construction

DID you ever think of the enormous amount of labor that makes it possible for you to talk to a person hundreds of miles distant? Take the wire, for instance. It had to be stretched, perhaps over mountains and through valleys, across rivers and around obstacles too difficult to surmount. It could not simply be laid on the ground: it was necessary to conduct it overhead and properly insulate it. That required the erection of supports, usually tall wooden poles, planted at certain intervals in holes bored in the ground. Think of the hundreds of miles of wire, the thousands of poles, the tons of glass insulators which had to be transported, the number of men engaged in the task, and the enormous amount of labor involved.

Formerly it required a crew of nine men to erect a single pole. As the work progressed, the distances over which these poles, the rolls of wire, and the working gangs had to be hauled by slow horse teams, increased. Relay teams had to be provided, which demanded additional horses and additional men.

The introduction of motor-trucks has completely revolutionized the work of telephone-line construction. A powerful motor-truck, equipped with lifting crane, winches, and all the necessary tools, now carries the rolls of wire, the insulators, etc., and hauls the trailers loaded with more poles than two or three teams of horses could pull formerly.

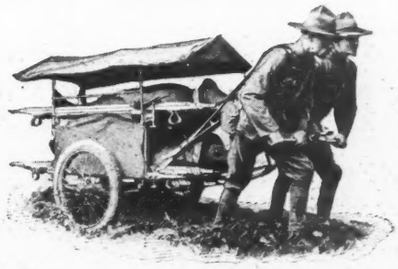
On the truck there is also ample room for the working crew, which now consists of just two men.



Two men, with this motor-truck, can plant a pole quicker and better than the crew of nine that was formerly required

This New Litter-Carrier Doubles the Service

OUT in No Man's Land, with the shrapnel splinters burying themselves into man and beast, quickness in rendering aid to the injured is more precious than anything else. The Medical Corps has designed a new type of litter-carrier which will enable stretcher-bearers to care for double the number of men they could handle without it. Where two stretcher-bearers now remove one wounded man to a place of safety in a stretcher, the new litter-carrier will make it possible for them to carry two.

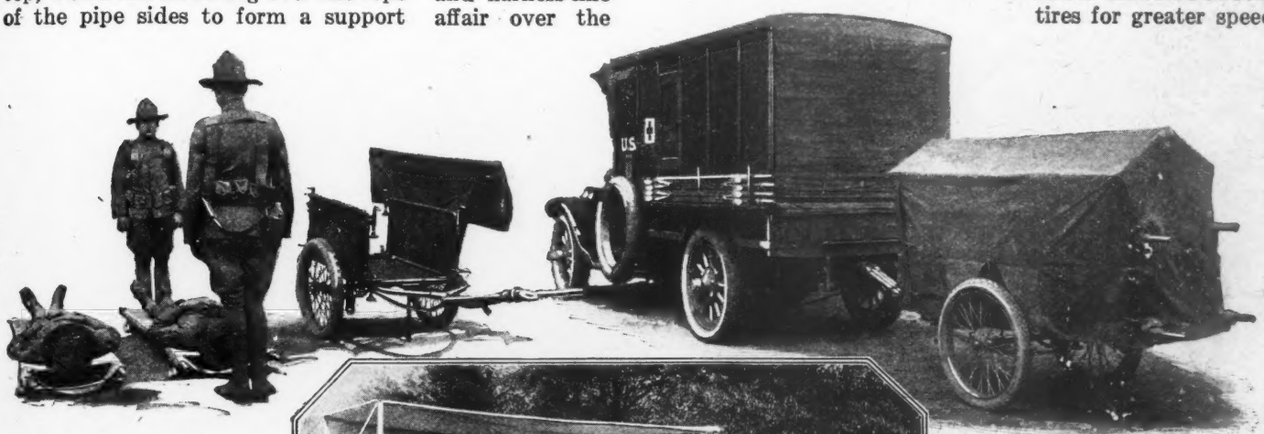


Two wounded men can be carried comfortably at one time in this litter

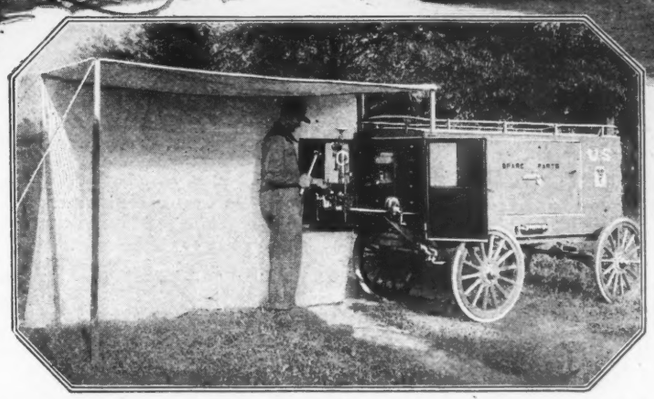
The new apparatus consists of a sulky-like vehicle with one axle carrying bicycle-like pneumatic tires. The body is made of ordinary pipe with canvas sides and floor. It has a folding top, which can be swung over the tops of the pipe sides to form a support for one stretcher, the second being carried directly below, just over the axle.

The vehicle is light, yet substantially made. It is pulled by means of a handle and harness-like affair over the shoulders of the stretcher-bearers. Because of the pneumatic tires, considerable speed may be made without causing excessive pain to wounded. One of these litter-carriers is to be attached to each of our front-line ambulances, and may be hauled back of the line by the motor ambulance and thereby increase its efficiency fifty per cent, since the ambulance itself carries only four wounded.

Another new type of vehicle now being supplied to our ambulance men overseas is a spare parts trailer which will carry enough parts to keep twelve ambulances in repair unless hit by a shell, when there would be little gain in picking up the pieces. The new trailer is of the four-wheeled type, and is mounted on solid tires for greater speed.



The sulky-like litter ready to receive its load. Pneumatic wheels make easy riding for the wounded



Twelve ambulances can be kept in repair by the aid of this spare parts trailer. It has a steel body, with trays to carry the necessary repair parts and a complete tool-kit

When the ambulances move up to the front, the new field litter tows easily behind. And when the ambulance hurries its load back to the hospital the trailer increases its carrying power by half, since the ambulance itself carries only four

Don't Scrap That Old Car—There's Money in It

THE tremendous decrease in motor passenger-car production, due to the demands of the government, has put a premium on the used car. A Richmond, Va., dealer awake to this, took the opportunity recently to do some unusual advertising.

He had purchased a fleet of motor-trucks in Newark, N. J., and at the same time picked up a number of used passenger automobiles. He loaded the small cars on the trucks, and the fleet started for Richmond. All along the route the unusual sight of automobiles carrying automobiles attracted attention, and the dealer could have sold his freight at a good profit many times.

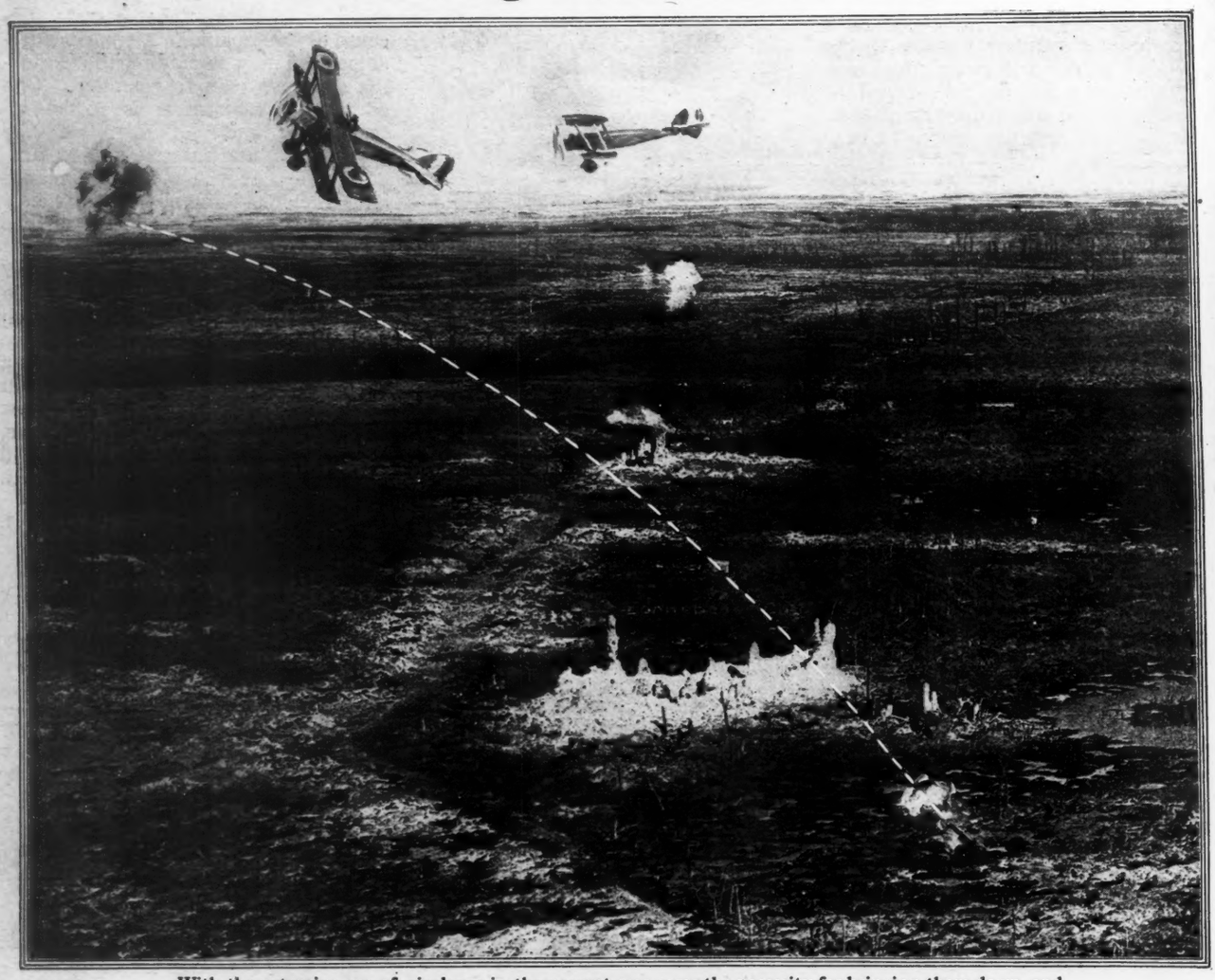
Don't sacrifice your old car. There is a lively market for it, and a little paint is a good salesman

The used car department of one company advertises by sending out an old car divided through the center by a partition on which is painted a sky-line to merge with the true sky, and with a dummy steering wheel placed on the side opposite the regular wheel.

One side of the car is generously splashed with mud and has worn-out fittings, while the other is resplendent in new paint and new upholstery.

The idea is, of course, to show what can be done by an alert dealer to make an old car attractive and therefore salable.

Out-Guessing Anti-Aircraft Guns



With the extensive use of airplanes in the present war came the necessity for bringing them down, and so anti-aircraft guns were invented. But air pilots are taught to out-guess the gunners below them

PART of every airplane pilot's training has for its object the avoidance of shrapnel. His one safety lies in out-guessing the gunners below. He has the advantage over them, in a sense, because he knows where he will be three seconds hence.

One of his first lessons is to keep his airplane between the anti-aircraft guns and the sun. As soon as the Germans begin firing he may adopt one of several courses. He may change his altitude; or he may change his direction; or he may combine a change of altitude with a change of direction —a course rarely followed, because it is seldom worth while to lose altitude.

From a range of twenty-five hundred yards, it takes a shell approximately seven and a half seconds to arrive. Hence the gunner must so judge the path of the airplane that in seven and a half seconds the shrapnel will meet it.

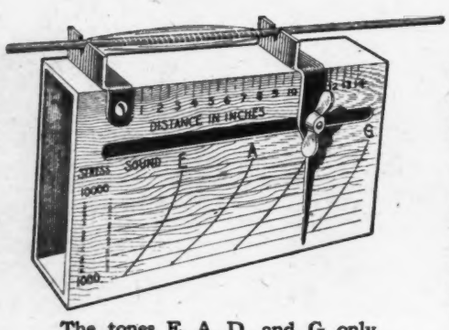
The pilot turns his plane immediately at right angles to his path, and as a result four or five shells are wasted. The German gunners are out-guessed.

How the Hoffman Wire Tuning-Box Works

WITH the help of the Hoffman wire tuning-box, the old "guess" method of tightening the bracing wires in airplanes is done away with.

This instrument consists of a light veneered sounding-box on top of which is placed two metal V-shaped saddles, one of which is the indicator.

Two scales are placed on the side of the box, one of which indicates the distance between the saddles and the other shows the stress required of a wire, which when supported between the saddles and vibrated, produces a certain tone, which is ascertained by means of a sound-meter, which can be obtained at any music store.



The tones E, A, D, and G only are used in this instrument: others may be added as they are required

The tone of every wire at the required stress is ascertained, and the movable saddle set to its proper position. The tuning-box is then placed against the wire, the saddles being held lightly against it. The wire is vibrated, and by means of the sound-meter and a turn-buckle is tightened or loosened to produce the required tone. When this is reached the wire has the correct amount of stress upon it. Each wire in the airplane being treated the same way makes the proper factor of safety positive.

Ford's Cavalry in Action

ALONG a roadway of Epides, the Germans were intrenched, and were putting up a stubborn defence with machine-guns against our troops. In the rapid advance our artillery had not yet been able to catch up with the infantry, and the thickly placed German machine-guns seemed to have the best of the situation.

It was impossible for the infantry to flank the position quickly, because the ground on either side of the road had been so cut up as to make it difficult to advance over; and to take the machine-gun nests by charging directly along the road meant big losses.

As the attack halted, a panting messenger reached the side of the battalion commander, saluted, gave a brief word, and was on his way.

"Wait a minute, boys!" shouted the officer. "We'll hold our attack. They are bringing up the Yankee cavalry."

Hardly had he spoken when up the road raced ten automobiles of the kind that have made Henry Ford famous. On each was mounted a machine-gun,—some boasted two,—and the little machines were going as fast as it is in a Ford to go.

They were unarmored, of course, and relied upon speed and the element of surprise to carry through the attack on the machine-guns. Fortunately, the Germans were no better off than we were in artillery, their guns having been withdrawn as a preliminary to retreat.

Straight toward the German lines went the little cars, spouting streams of bullets from either side as they neared the machine-gun nests. The Germans held their ground until the automobiles were almost upon them; and then, seeing little chance of "Kamerading" to this strange cavalcade, they beat a hasty retreat.

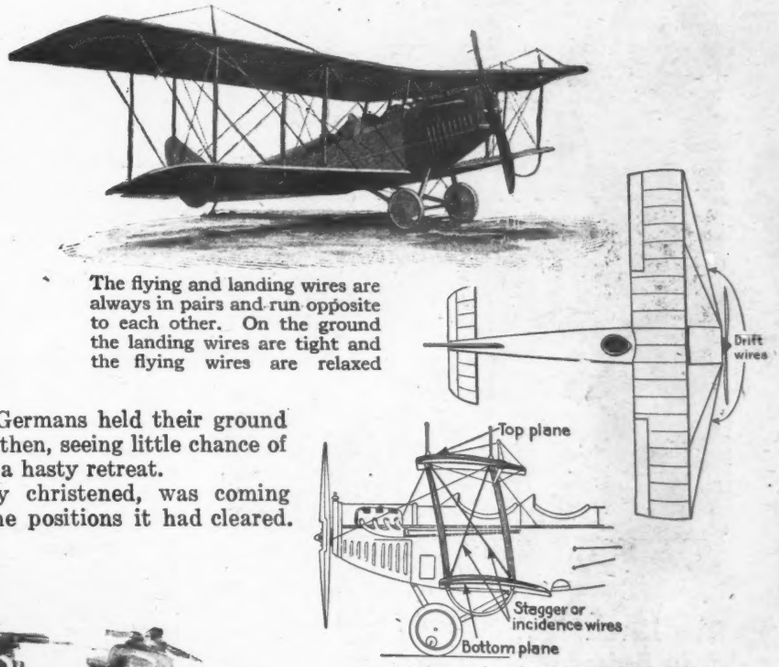
As the "Ford Cavalry," as it was promptly christened, was coming back, it met the infantry going up to occupy the positions it had cleared.

Spouting streams of bullets from either side, the little cars raced straight toward the German machine-gun nests. They were unarmored, of course, and relied upon speed and the element of surprise for the success of a real Yankee trick

The Life-Lines of the Airplane

THE airplane shown below is a standard Curtiss training biplane, hundreds of which are in daily use throughout the country.

The fighting planes do not rely on wires for support, since their construction is such as to make wires nearly unnecessary. But in the training planes the airman's life depends a great deal on the bracing wires.



The flying and landing wires are always in pairs and run opposite to each other. On the ground the landing wires are tight and the flying wires are relaxed

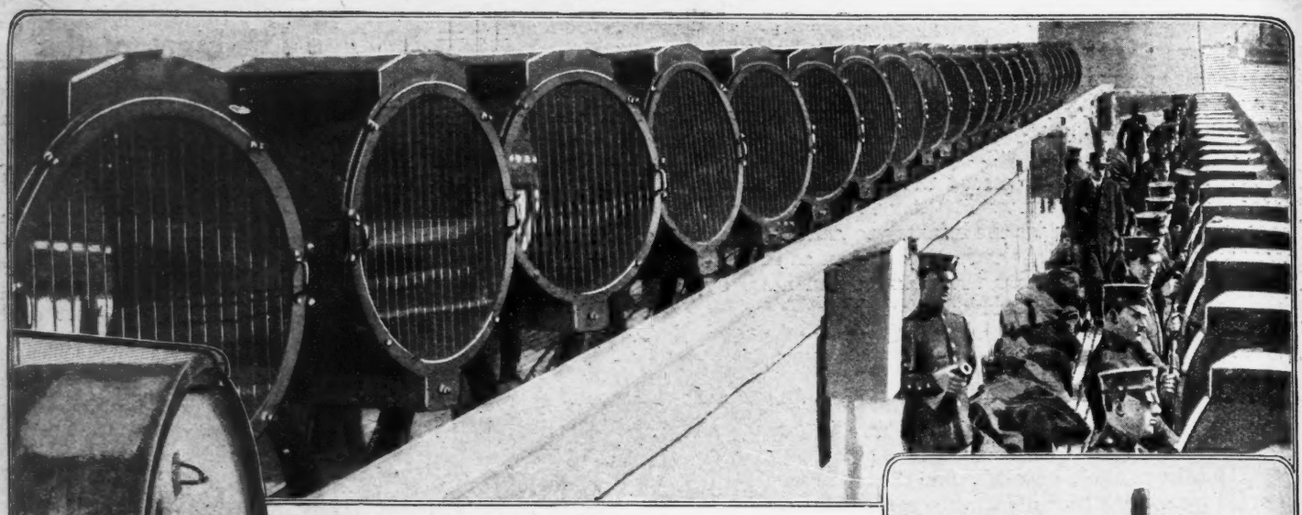
The stagger wires keep the difference in the alignment of the top and bottom plane constant. No machine is flown until the wires have been examined

You will notice that the flying and landing wires, which are always in twos, run opposite to each other. When the plane is on the ground the landing wires are as tight as drums, supporting the weight of the wings; and the flying wires are relaxed. In the air the flying wires take up the strain, and the landing wires are idle.

Wires play an important part in the under-carriage too, as they brace the chassis against the many shocks of landing. At the end of each wing extension wires keep the overlapping upper planes in position. The drift wires, running from the main planes to the front of the engine-bed, hold the wings rigid and cut down resistance.

The stagger wires keep the difference in the alignment of the top and bottom plane exactly the same as when the machine was assembled in the factory. Bracing wires are kept taut by means of special turn-buckles at each end of the wire.

No machine leaves the ground until all these wires have been gone over and tested. To take a chance without inspection might mean sudden death.

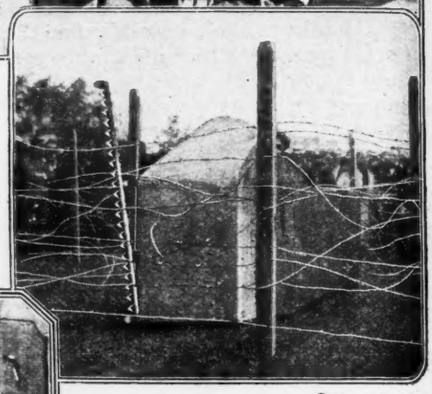


Learning to Use Giant Searchlights

HUGE searchlights are used in the defence of our coasts and harbors. The large parabolic mirrors throw out the rays of a high-power electric arc to a distance of many miles.

The picture above shows a class of coast guards receiving instruction in the use of the searchlights.

British Official Photograph



© Harris & Ewing

It Clips Its Way through Barbed Wire

HAVING converted our farm tractors into tanks, and the "stink-pot" of the Chinese into gas-shells, we now turn barber-shop experiences to account. At least, it seems to us that the remarkably effective wire-cutter recently shown by its inventor, John E. Logan, before officers in the Capitol grounds at Washington, is reminiscent of the type of clipper applied to the back of the male neck.

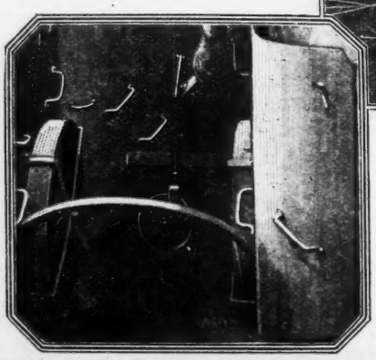
The machine, which is armored and of bullet-deflecting shape, is operated by two men. One propels the machine, while the other manipulates the cutter.

As shown in the photograph above, the cutter is a bar on the forward side of which are numerous steel teeth.

When the machine brings this bar against a wire entanglement the wires fall between the teeth. Push down a lever within the steel body and the teeth are brought together with tremendous force. The men are protected by the body from the flying ends of the wire.

On its demonstration, the machine cut through seventy-two strands of a model entanglement in nine seconds less than half a minute.

The picture in the center of the page shows the interior of this curious war machine.

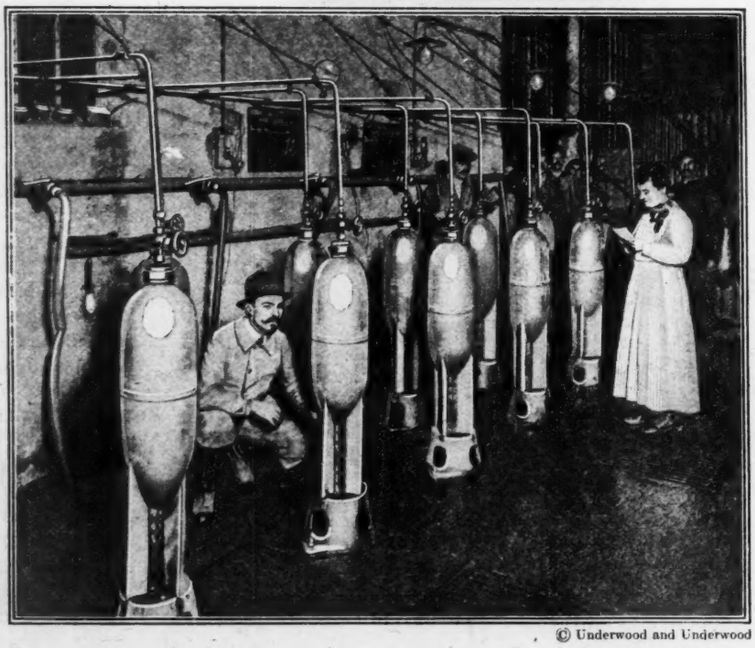


The Latest Thing in Bedrooms

THE expression of surprise at sleeping accommodations must have palled on the lips of men in active service. The Tommies here shown climbing into some vast tank in the ruins of a town in northern France seem bored rather than excited at their novel dormitory.

One man, transferred from trenches to rest camp, is alleged to have passed a sleepless night.

He missed his usual lullaby of shell-fire.



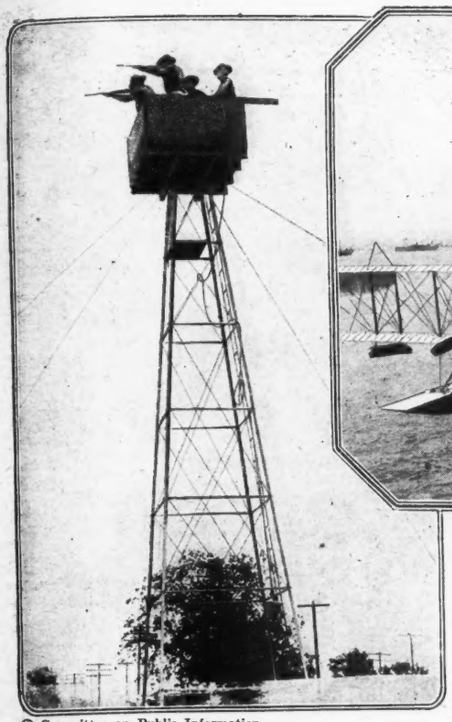
© Underwood and Underwood

Women Bosses

HERE is a sight that will gladden the hearts of feminists—a forewoman bossing a gang of subordinate males. This happy condition exists in a French factory for making airplane bombs, where this photograph was taken.

The bombs, which are standing on the floor, are being tested for weakness. This is done by compressed air, which enters the bombs through pipe-lines. As air is forced into a torpedo, any weakness in the metal will manifest itself. For instance, if the joinings are not perfect the air will hiss out through the cracks; or if the metal is exceptionally thin in any place it will start to bulge under the extreme air pressure.

The men make the observations, but it is the woman who keeps all records and bosses the job. *Vive la France!*



© Committee on Public Information

The Army Shoots Clay Pigeons

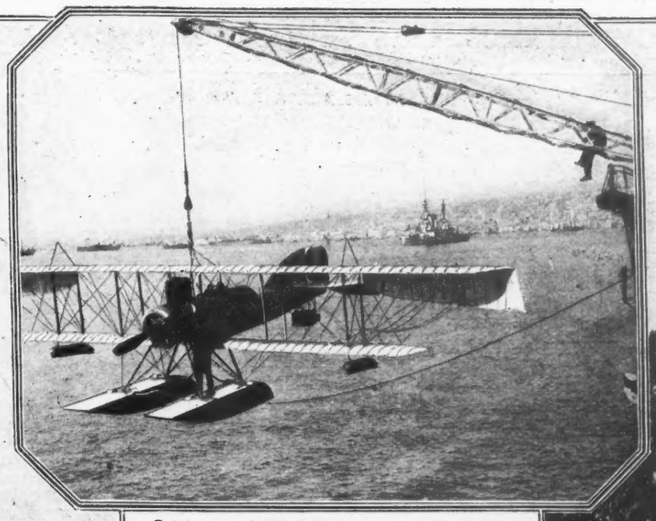
AS every rifleman knows, shooting from ground level and shooting from a height are two different things. This is the reason why the United States Government provides, for those likely to see aerial or mountain fighting, a course on towers.

At an elevation of fifty feet, the soldiers practise on clay pigeons, launched both from the ground and from the top of the tower.

Mending the Bones of War Cars

WELL back of the lines in France there are enormous open hospitals for broken motor-trucks.

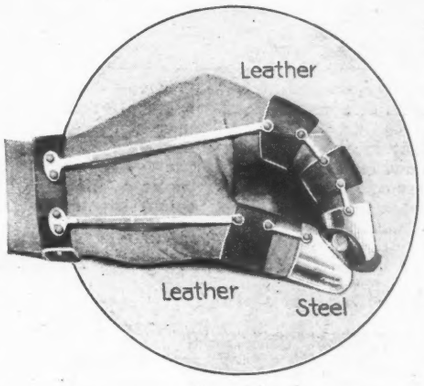
Some of the British transport vehicles in the picture below seem ruined beyond hope. But not so. If nothing is left but one wheel, that wheel will help to repair some other car having three. The most complete smash imaginable always yields a good supply of nuts and bolts, which, while the hopelessly twisted metal is sent to the scrap heap, are stored for repairs on some future casualty of the same make.



© International Film Service

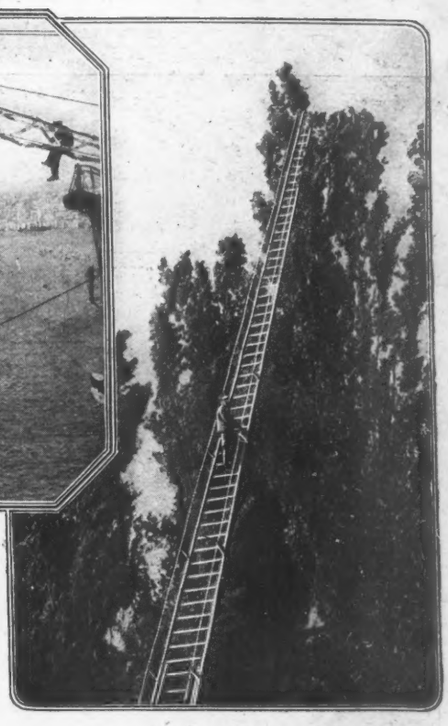
Launching a Hydro-Airplane

THE picture above shows the launching of a hydro-airplane from a British battleship in the harbor of Saloniki. The aquatic biplane is suspended from the end of the cable by wires, and carefully lowered until it rests upon the water.



Armor for the Picture-Hanger

AFTER he had injured himself a great many times by smashing his fingers with a hammer, Nathaniel Carr Fleming, of Coldwater, Kas., invented the finger-armor above. He has secured a patent on it.



Watching the Shots Fall

AT first glance you would suppose that the men climbing this ladder are fruit-pickers. Then you notice that they are soldiers and that the trees are not fruit trees at all.

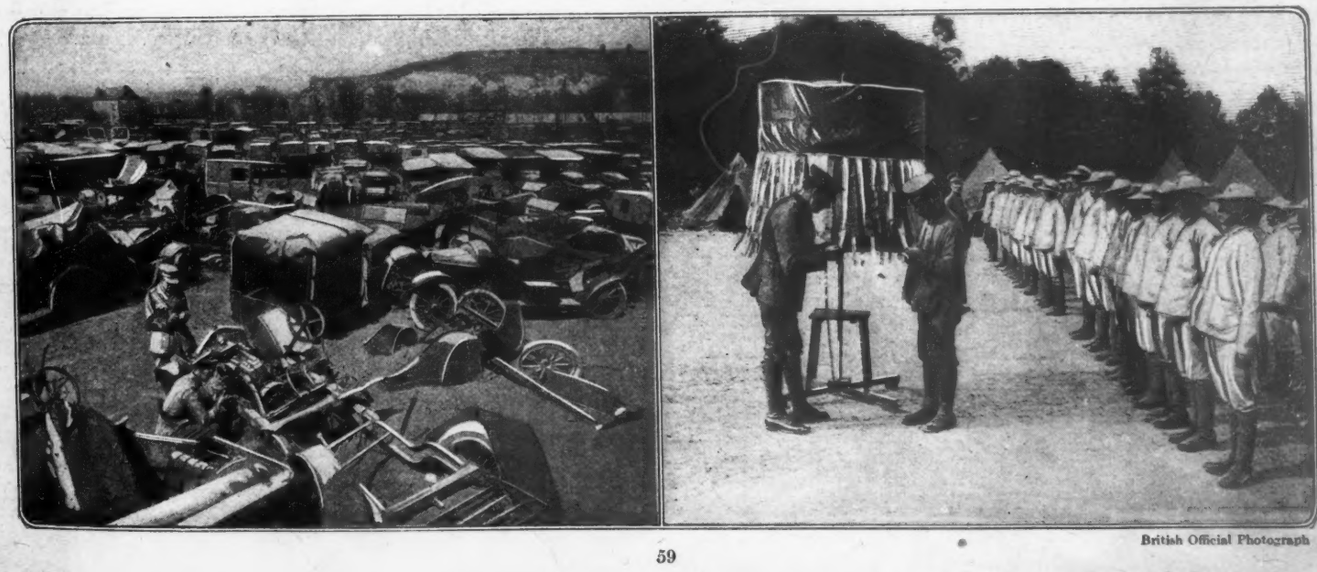
The truth is that the ladder is merely one of a hundred different devices for climbing to a great height in order to observe the effect of artillery fire on the enemy.

The ladder must be a temporary expedient, or it would be camouflaged. A watchful enemy aviator would see it at once.

East and West in France

NO, these Chinamen are not going to have a May-pole dance. They are hard-working, worthy laborers in France, lined up for roll-call. The seeming May-pole is the Chinaman's idea of a roll-book. On the streamers are written the names of the men.

When we see the English officer calmly inspecting these Chinese names, we begin to lose faith in the proverb about East not meeting West before the judgment-day.



British Official Photograph

Scow Makes Gas Attack on New York

Passengers on the Fall River liner Providence, docked at her pier in New York, recently had a remarkable demonstration of the possibilities of a gas attack by sea.

The boat had reached her pier in the early morning, and the passengers, still asleep in their berths, were awakened by choking fumes. Meantime half the water-front was coughing, and the police were scurrying around to find the reason for it all.

They found that the fumes came from the most peaceful of craft, a railroad scow, which had broken from her pier farther up the river. The scow's cargo consisted of twenty-five tons of chloride of lime that had been condemned by Federal inspectors the day before. During the scow's runaway journey the choppy waves of the river had splashed over her rail, causing the decomposition of her cargo and the liberation of the gas.

No More Waiting While They Figure Your Interest

INTEREST BEARING AUTOMATIC SAVINGS CERTIFICATE
This Certifies that
MINNEAPOLIS BEDDING CO.
has deposited in
ST. ANTHONY FALLS BANK
MINNEAPOLIS, MINN. - 17-6
TWENTY DOLLARS
FOR VALUE NOW SEE THE TABLE
Payable with interest as shown in the table to _____ or bearer
ORDER: PAY THIS CERTIFICATE, TO MY ORDER
Signature PAYABLE TO BEARER UNTIL SIGNED HERE Owner
SPECIMEN
KEEPS MONEY GROWING
DATED FROM JAN. 9, 1917 VALUE $ 20.00
APR. 9, 1917 VALUE $ 20.20
JULY 9, 1917 VALUE $ 20.40
OCT. 9, 1917 VALUE $ 20.60
JAN. 9, 1918 VALUE $ 20.81
APR. 9, 1918 VALUE $ 21.02
JULY 9, 1918 VALUE $ 21.23
OCT. 9, 1918 VALUE $ 21.44

A certificate that shows the interest on your savings-bank deposit at different periods. It has proved very popular with depositors whose banks issue them

SOME savings banks have done away with much of the delay occasioned by reckoning interest and setting it down in the pass-books of depositors by using certificates devised by J. E. Hanzlik of Minneapolis, Minn. These certificates show the interest that has accrued on different given amounts at various times.

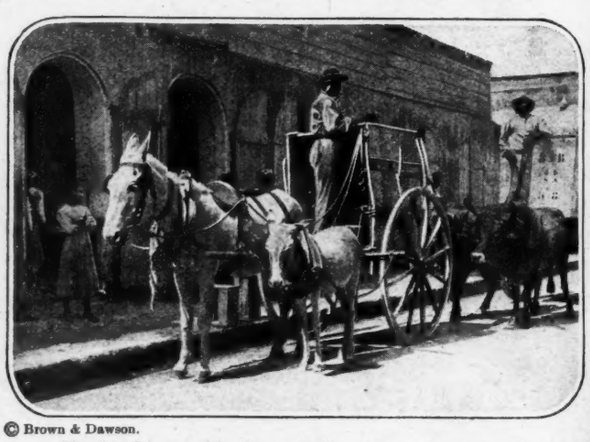
If, for example, you deposited $20 on January 9, 1917, you received a certificate showing that that amount had been placed to your credit in the bank. At one side of the certificate is a table indicating that on April 9, 1917, the interest on your deposit, reckoned at four per cent, totaled twenty cents, and so on. Thus on October 9, 1918, you can see by glancing at your certificate that your interest has swelled to $1.44.

Aside from the avoidance of delay, depositors favor the savings certificates because they can see at a glance just what amount is due them.

Mule-and-a-Half Power in the West Indies

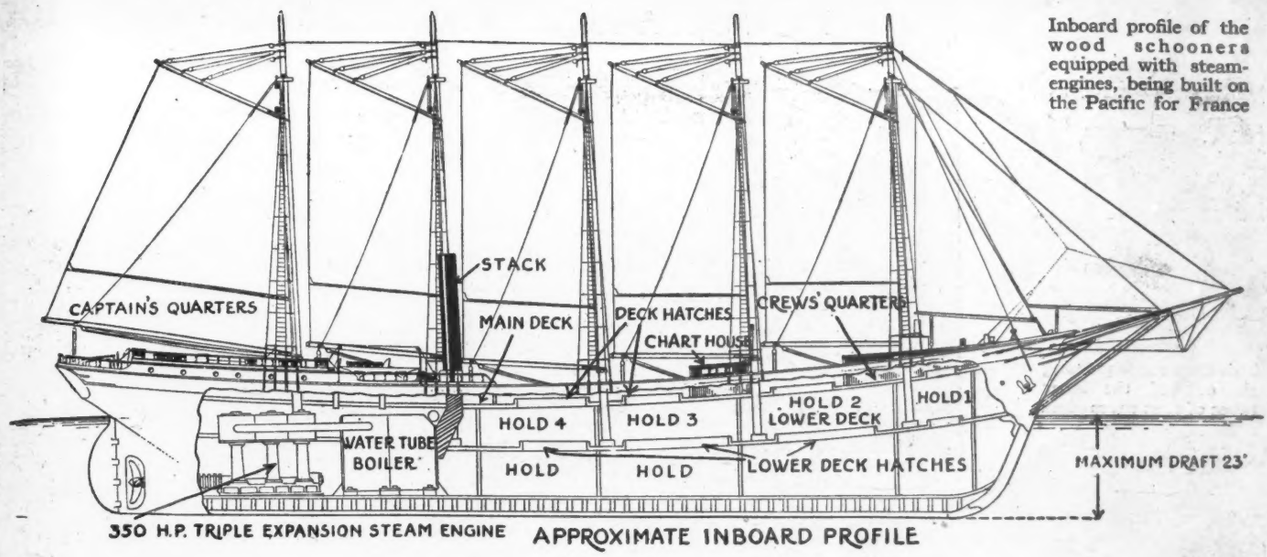
IT offends the West Indian to see natural power going to waste. West Indian carts are nominally one-horse vehicles. The first measure of conservation is, obviously, to replace the horse by the still more sturdy mule. The next measure is to insure that the cart carries on each trip its fullest possible burden.

It is at this point that the problem arises. The mule points out that he has seventeen sixteenths of the amount he can possibly draw, and protests. A rash Northerner would probably cry in his haste, "Harness another mule!" The West Indian keeps the extra mule in the stable, and adds an auxiliary donkey.



© Brown & Dawson.

If a load is too big for a single mule and too small for a team of mules, why isn't this the solution?



Inboard profile of the wood schooners equipped with steam-engines, being built on the Pacific for France

Steam, Sail, and Wood Meet Again in New Craft

WHAT is out of place on the huge five-masted sailing-schooner in the picture below? Why, it's the smoke, of course, and the smoke comes from two tall stacks just in front of the fourth mast.

The schooner is almost reminiscent of the balmy days in the early part of the nineteenth century when the sailing-ships of the United States ruled the seven seas. Yet the ship shown herewith is not to fly the American flag, although it was built in the yards of the Foundation Company on the Pacific Coast. She is one of forty 3000-ton wood schooners contracted for by the French government as one of the ways to replace its transatlantic and coastwise ships that have been sunk by German submarines.

Follows Conventional Schooner Design

Except for the unusual fitting of the engines, the ship follows the conventional schooner design. The inboard profile pictured above shows the approximate location of the two coal-fired water-tube boilers and the two 350-horsepower triple-expansion steam-engines, one mounted on each side of the center-line and driving its own screw propeller.

Two stacks are provided, one for each boiler. They are mounted side by side, crosswise of the ship instead of on the longitudinal center-line, as is usually the custom on steam vessels.

The schooner illustrated, the *Gerbeviller*, which is the first of the forty-boat fleet to be launched, was also the first of the wooden ships to be launched at the Tacoma (Washington) shipyards since the beginning of the war.

Vindication of Goethals' Plan?

The *Gerbeviller* steamed away from the fitting-out yards of the Foundation Company on the Hylebos Waterway on June 1, 1918, and on her trial trip she easily made a speed of ten knots over a measured course.

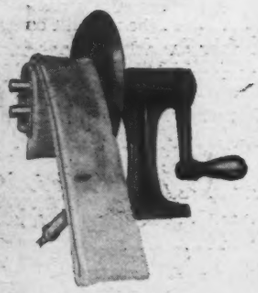
Although unladen, that speed was accomplished without the development of any appreciable amount of vibration which might tend to shake the heavy engines loose from their foundations—one of the chief objections brought against General Goethals' plans of building a great fleet of engine-driven wood ships when the Shipping Board was first formed.

Satisfactory Trial Trip

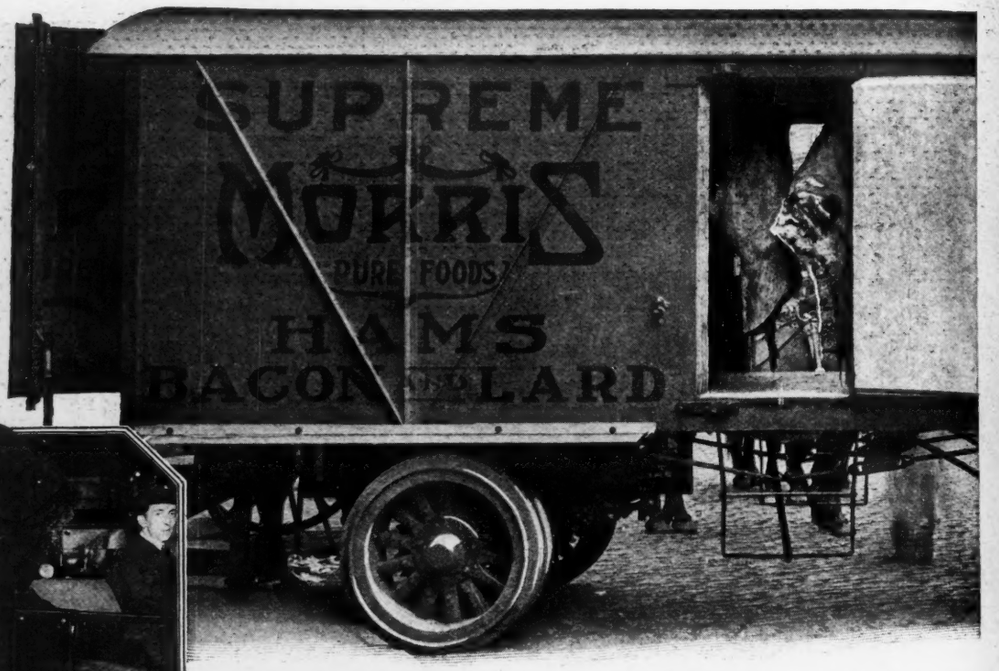
The trial trip of the *Gerbeviller* was so satisfactory that it is expected that her sister ships will be able to develop a speed of more than eight knots without the use of sails when fully loaded. The over-all dimensions of the schooner are: Length, two hundred and eighty feet, beam forty-five and a half feet, draft twenty-three feet.

It looks like one of the old five-masters seen in Casco Bay before the war; but it is one of forty wood schooners built to take the place of torpedoed French ships

Mechanical Aid and Comfort for

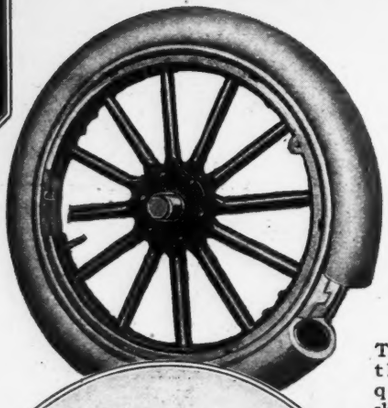


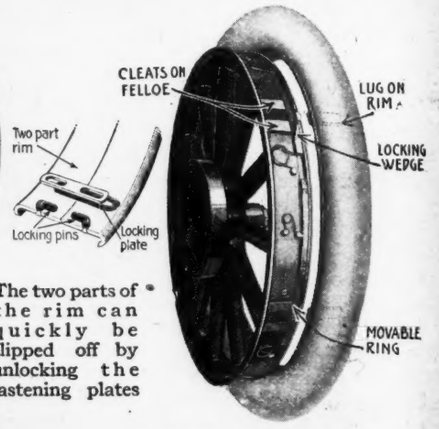
This device for squeezing air out of the inner tubes of tires saves time



A big refrigerator trailed by a motor-truck for distributing meats to branch stations

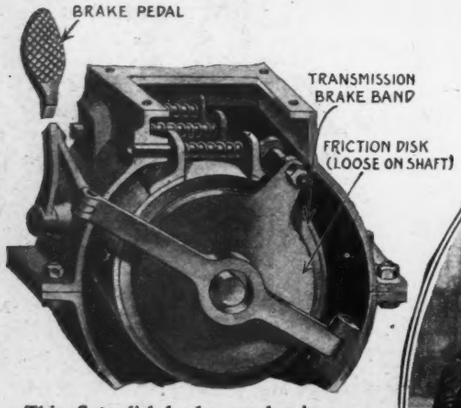
Just step in—your weight will automatically open and close the sliding door





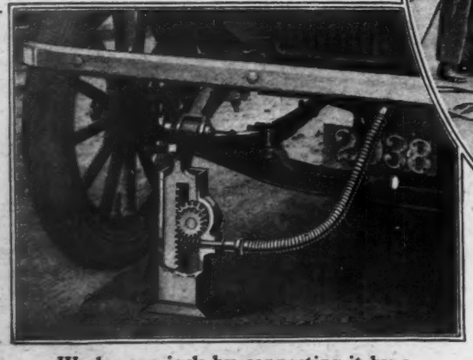
The two parts of the rim can quickly be slipped off by unlocking the fastening plates

With a T-shaped key any child of ten can take off this rim in one minute

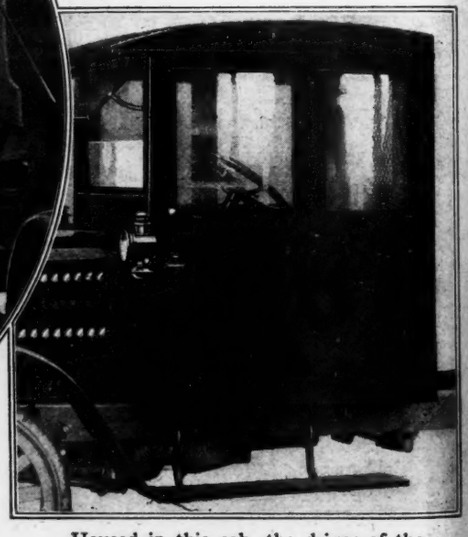


This flat disk-brake works in conjunction with the circular band-brake

How they clean sewer catch-basins in Cambridge, Mass. The work is done with the help of a motor-truck specially equipped for the purpose with a hoisting and dredging apparatus

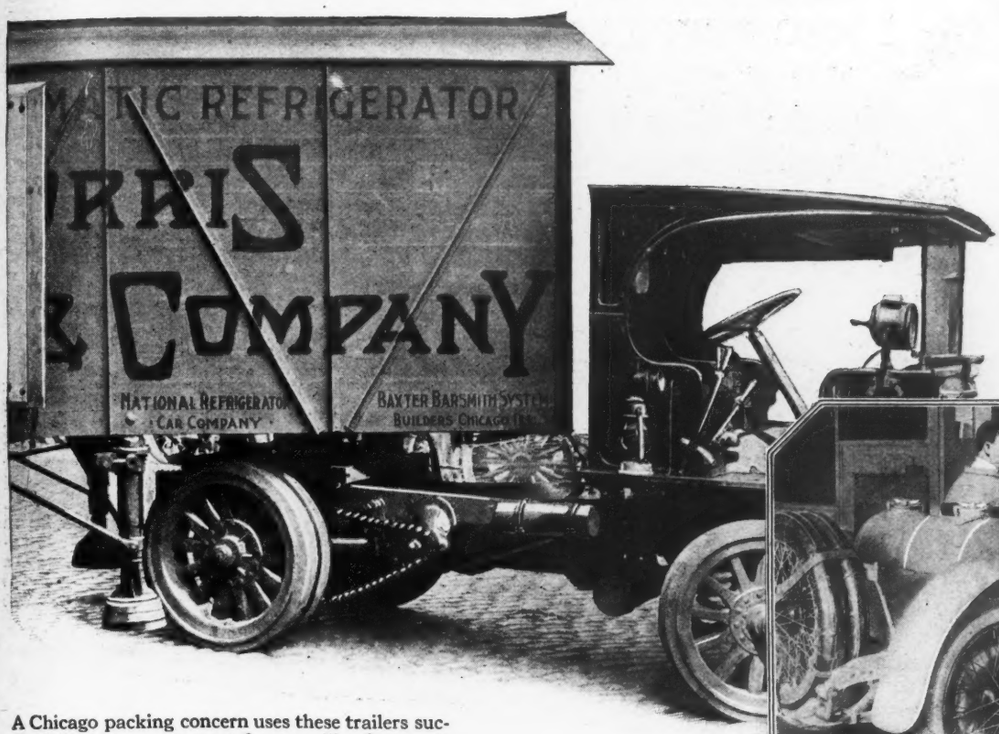


Work your jack by connecting it by a flexible shaft with your engine-shaft

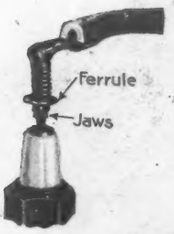


Housed in this cab, the driver of the motor-truck can brave any weather

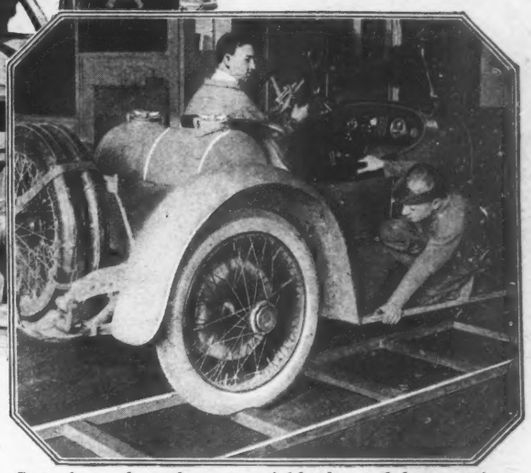
the Automobile Owner and Driver



A Chicago packing concern uses these trailers successfully to prevent meat from spoiling in transit

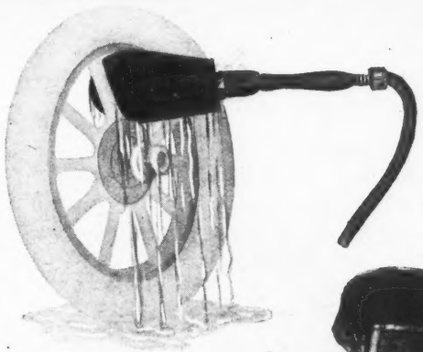


Two threaded jaws, secured by a ferrule held in place by a spring, keep the spark plug from becoming loose

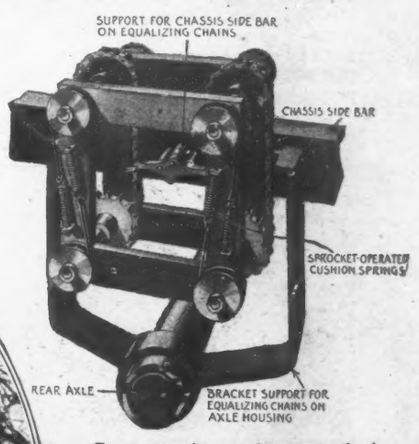


Squeaks and rattles are quickly located by running the automobile back and forth over this frame

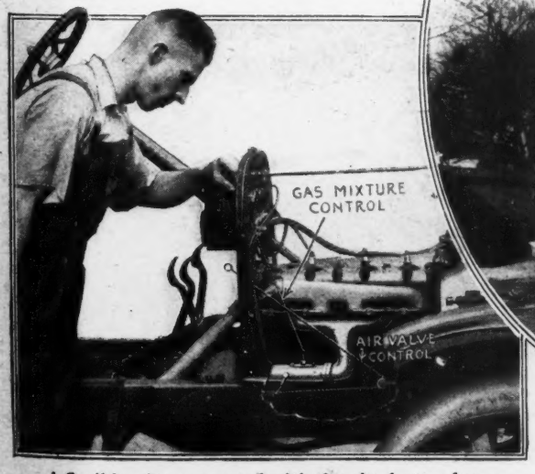
When you draw gasoline from this pump, you can see the liquid through the glass wall of the measuring cylinder



Water forced through the holes between the bristles of this brush makes washing the wheels easy

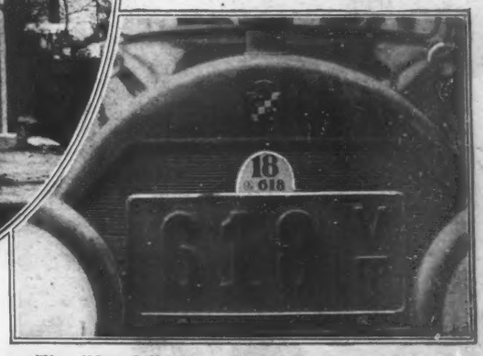

SUPPORT FOR CHASSIS SIDE BAR ON EQUALIZING CHAINS
CHASSIS SIDE BAR
SPROCKET-OPERATED CUSHION SPRINGS
REAR AXLE
BRACKET SUPPORT FOR EQUALIZING CHAINS ON AXLE HOUSING

Compensating springs attached to chains running over pulleys is the feature of this road equalizer



A flexible wire connected with the air-shutter lever of your Ford makes starting in cold weather easy

This old windmill tower has been made useful as an automobile garage



The life of license plates may be prolonged by using a separate plate for the year number

When There's One More River to Cross

How the soldiers ferry themselves over when bridges are down

Wet clothes hamper a fighter. If there is time, the "doughboys" strip to the buff at the fords. The entire field equipment of an infantryman can be packed in a shelter-tent and carried either on the man's head or on his back

Trust any kind of raft that keeps your powder dry—although modern explosives will stand some wetting. A triangular craft of light boards will carry a swimmer's outfit. If the soldier can fasten a shelter-tent bundle underneath to increase buoyancy, his rifle is sure to be out of the wet

A barn door nailed on poles and provided with outriggers makes a good emergency ferry-boat for Yank or Tommy; but a single beam with board outriggers knocked from a handy fence makes a splendid catamaran, and a trench shovel a very efficient paddle. High-water trousers are the proper costume for this aquatic sport

Feed sacks packed with straw will serve to ferry the saddles over. Poles or lances stuck through the loops of the sacks form the framework on which the saddles are adequately supported, with a carbine on either side

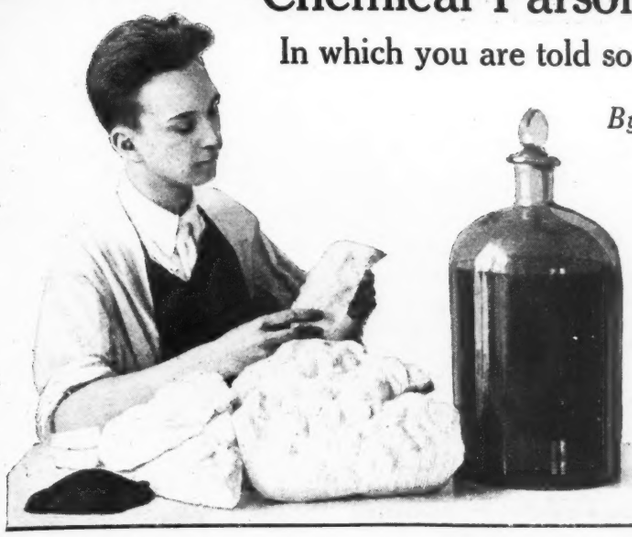
When the water is deep and there isn't time to strip, coupled poles enable a man to pull himself across

If the soldier is a good swimmer, his raft becomes a welcome ferry for the arms and equipment of some less gifted pal

Chemical Parsons in War Service

In which you are told something about catalyzers

By John Walker Harrington



Left: A small heap of the catalyzer, liquid oil, and solid, hydrogenated oil

Right: $150 worth of palladium black, a powerful catalyzer

ALTHOUGH "chemical parsons" are only substances, they are helping to win the war. The chemists call them thus because they marry certain elements without themselves entering into the new combinations. Technically, they are catalyzers; that is, they affect the velocity of a chemical reaction without appearing in the final product.

The parsons attract atoms to their surfaces, and hold them there for union with other atoms. They condense gases, retain them until the new substance is complete, and then preside over other unions.

Platinum is the primate of chemical parsons. It gathers up oxygen and brings it into new relations. In the manufacture of sulphuric acid it adds more oxygen to the dioxid of sulphur. That liquid, by its action on Chilean nitrates, gives us the nitric acid that is the foundation of practically all the high explosives of modern warfare. Platinum is also used in carrying oxygen to ammonia.

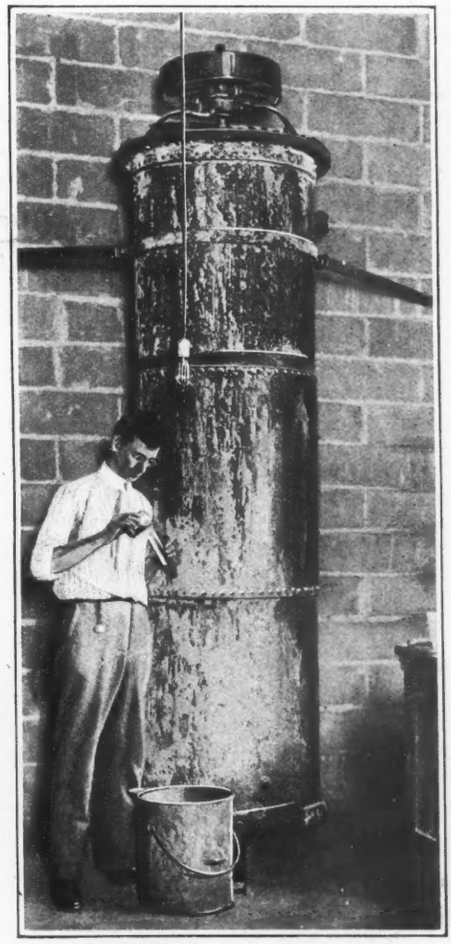
Platinum to Help Win War

Although platinum is not a beautiful metal, it is in much demand for setting diamonds and other precious stones, because of its great strength; also it is more costly than gold. Collodial solution of platinum, palladium, osmium, and iridium are extensively used to promote processes of war industry. Catalyzers are of service in aniline plants. Were it not for vanadium pentoxid the use of coal-tar products would be smaller. If one part of this rare salt is added to 270,000 parts of aniline salt, there will be produced speedily a fine aniline black, an indispensable dye. From coal-tar colors to ammunition is no far cry.

Common metals also have their place in bringing other substances into one. Pure iron was extensively employed by the German chemist Dr. Fritz Haber for the uniting of hydrogen and nitrogen in making ammonia.

The whole world, as a result of the war, is lacking in fat for food. All kinds of butter substitutes have been contrived, and hydrogen is used to solidify the oil of cottonseed and the olive.

Finely divided nickel or nickel oxid is the means of adding hydrogen.



One of the big converters for the hydrogenation, by means of catalyzers, of liquid oils or fats

Complicated special machinery has been devised for bringing about these unions, and millions of dollars have been invested in the hydrogenation of oils. The value of all these oils is considerably enhanced by this process, and the chemical parson is becoming more and more in demand. With the aid of nickel, olein is changed to stearin as if by magic.

Much original work along these lines is being done by Mr. Carleton Ellis, author of "The Hydrogenation of Oils," through whose courtesy photographs for the POPULAR SCIENCE MONTHLY were taken in his research laboratory at Montclair, N. J., showing his assistants working with the aid of chemical parsons.

Soup and Soap

It is only recently, in this country, that we have realized that maize contains a large proportion of nutritious oil. The Indians knew all this years and years ago. The old men used to sit around the fire waiting for the squaws to finish boiling the corn soup—a dish as rich as chowder and as full of nutriment as beef stock. From corn oil to corn butter is only a step.

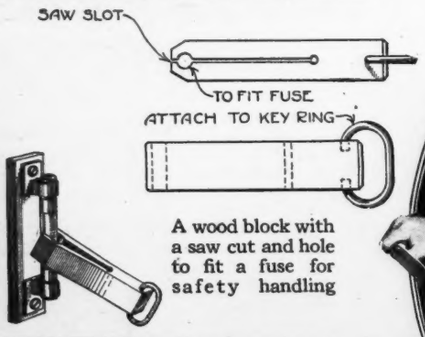
For the making of soap the use of a solid fat is desirable, so various oils are changed into the firmer consistency before combining them with the alkalis. In cities a grease of rich quality is obtained from garbage, which, with the aid of nickel, is converted into a good grade of hard soap grease. Saponification is accelerated by the assistance of the chemical parson.

In view of the many essential industries in which these agents are employed at present, every effort is being made by the American Chemical Society and allied organizations to further their use.

Let Machines Do Your Work

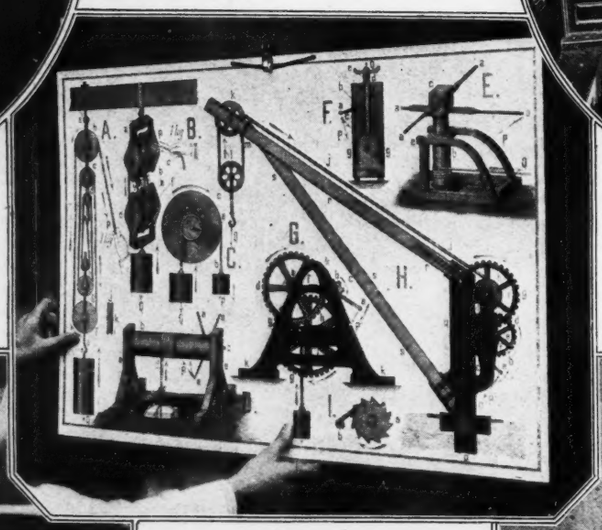
A few labor-saving devices that make it easier for the mechanic

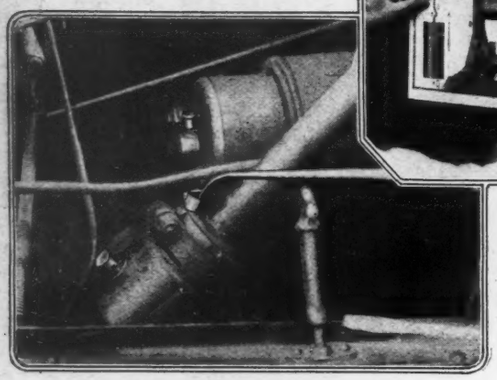
This cutter-holder makes it possible to get any desired bevel or angle on a chisel, plane, or other cutting tool. It is a boon to both the skilled and unskilled workman



A wood block with a saw cut and hole to fit a fuse for safety handling

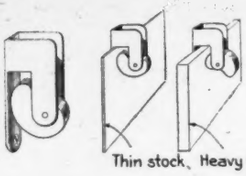
Dowels of varying sizes and lengths, and rods of practically any length, may be quickly turned out with the help of this machine for the cabinet-maker or builder

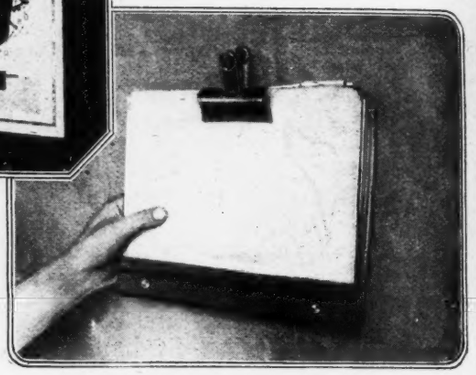




A one-piece body with a spring-operated cover (the spring being inclosed in the cup) for lubricating machinery

Above and below is shown a handy wall-hanger for large drawings and the like. The cam-shaped piece easily adjusts the opening for various thicknesses

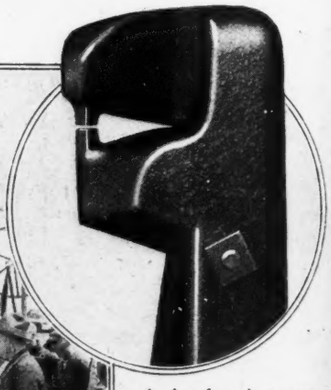




An ordinary large paper-clip used to attach papers to a board may be bent in order to hang papers on a wall

This oil-can carries a disk which, when depressed, forces the plunger into a reservoir located at the base of the spout and ejects the oil

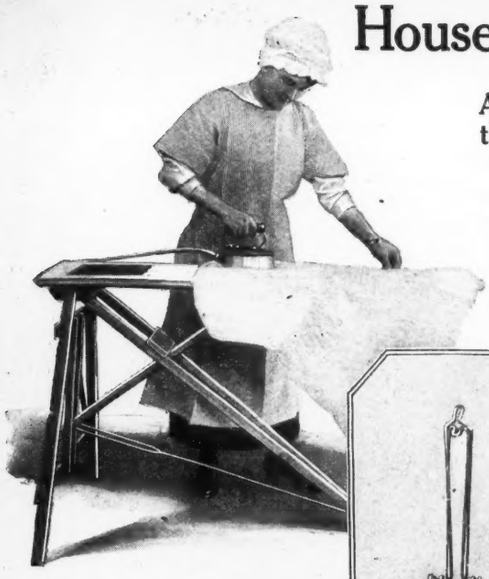
This large engine-driven refilling machine has made its appearance in fruit-growing sections. It digs, breaks up, raises, and replaces the earth in planting trees



A simple gripper to turn a loop in barbed or plain wire, to take up slack. Each loop takes up about one inch of the wire

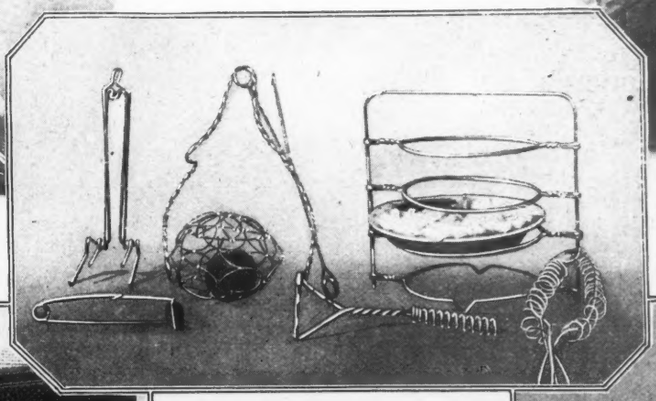
Housekeeping Made Easy

A few labor-saving devices for those who work in the home

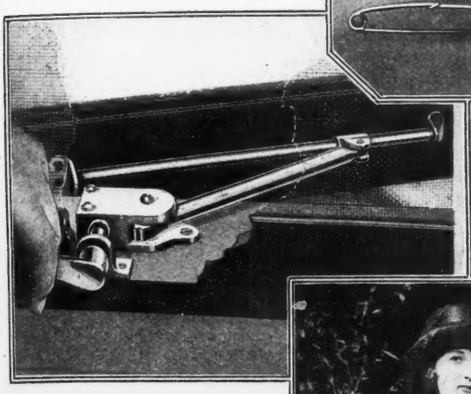


A flat-iron rest made of a series of rollers, so that the iron is easily pushed off and on the clothes

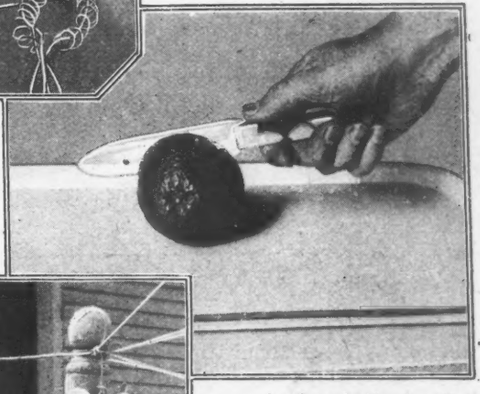
A foot-warmer of metal covered with plush. The heating element is non-inflammable



Wire kitchen utensils: a plate-lifter, gas-lighter, kettle mat, pie-fork, potato-masher, pie-rack, cork-puller, and cake-beater



A casement window-opener and adjuster which, being operated by a crank within the house, does not interfere with the screen that is set between



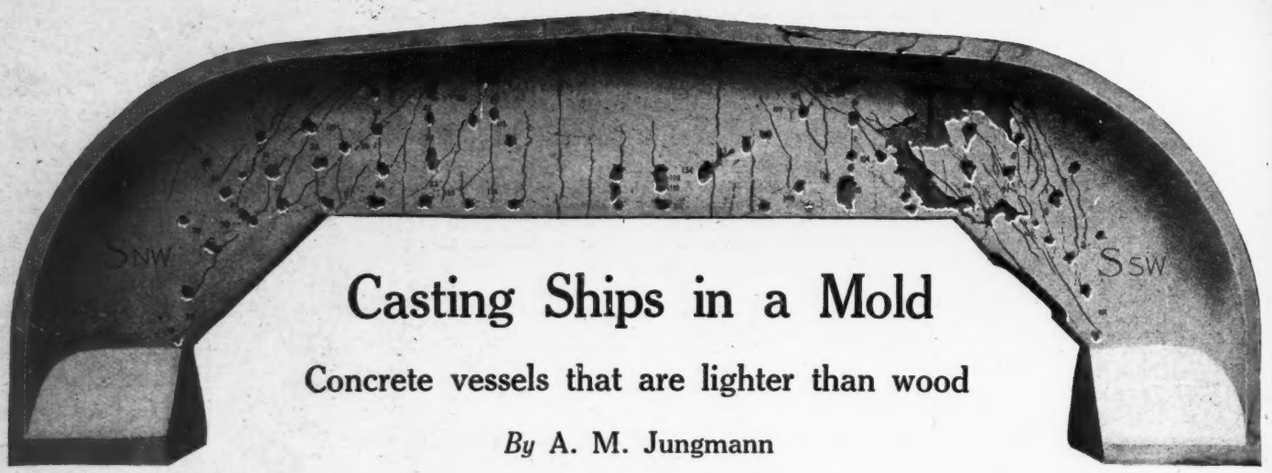
A glass knife, handle and all, the edge being ground by a special process. This knife is specially adaptable for cutting lemons and other acid fruits

A snake decoration to be hung on the door-casing on Hallowe'en, to give the guest a decided thrill

Another Hallowe'en decoration. This one is to be hung back of a light or translucent shade. Its joints can be set in any grotesque posture desired

A progressive grocery-store owner provides paper bags with handles, to encourage patrons to carry home their purchases

A rack for holding glass jars to be used for protecting tender plants in a garden. The same jars may be used later for canning vegetables



Casting Ships in a Mold

Concrete vessels that are lighter than wood

By A. M. Jungmann

CONCRETE looks like stone, and everybody knows how quickly a stone sinks when it is cast into the water. That probably accounts for the idea that a concrete ship must be very heavy. But according to R. J. Wig, Chief Engineer of the Department of Concrete Ship Construction of the United States Shipping Board, a new concrete material that has recently been developed will enable us to build concrete ships twenty per cent lighter than wood ships.

Why a Ship Floats

As a matter of fact the same inquiry that now arises about concrete ships arose when ships of iron or steel were first built: how can they float, being so much heavier than water? The ability of a ship to float does not depend upon the buoyancy of the material used in its construction, but upon the weight of the ship compared to an equal volume of water. So long as the ship is lighter than the water, it will float, whether it is made of wood, steel, iron, or concrete. A ship floats for the same reason that a china cup or a tin box floats.

While concrete ships are not new, —the first one was built in France by M. Lambot in 1849, —the use of reinforced concrete for the building of a great merchant marine really dates from the success of the *Faith*, a concrete cargo steamship of about 5,000 tons, which was launched in 1918, and which is now successfully plying the waters of the Pacific coast.

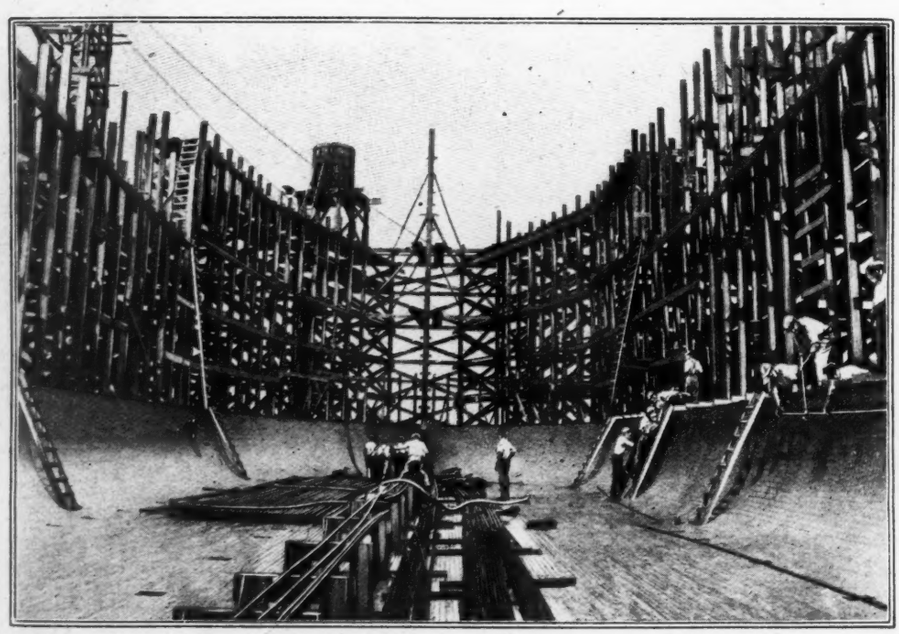
When the *Faith* took to the water, many persons predicted that she would not last any time at all. But her behavior under all conditions, from calm seas to severe storms, has settled the question as to the worth of concrete ships. She can withstand the heaviest seas, and is as easy to handle as any standard wood or steel ship. In fact, the Department of Concrete Ship Construction of the Shipping Board has made contracts for more than forty ships—cargo-boats of 3,500 and 7,500 tons dead-weight capacity, and tankers of 7,500 tons dead-weight capacity.

Construction Not Like Steel

The construction of concrete ships is something very different from the construction of either a steel or a wood ship. First of all, a wooden mold is made in the shape of the outside of the ship. Then the reinforcement is put in place, and secured so it cannot move. After that the inside wall of the mold is set in place just the right distance from the outside wall to allow for the slab and the ribs. When the molds are completed and the reinforcement is in position, the concrete is poured into the molds, or forms, in such a manner that every bit of the steel reinforcement is thoroughly covered.

As far as possible, the concrete for the bottom, frames, shell, and deck is poured in one continuous operation. When completed, the hull is one solid mass without pieces or patches. It takes about two weeks for the concrete to harden. Then the wooden forms are removed, and a solid ship is the result.

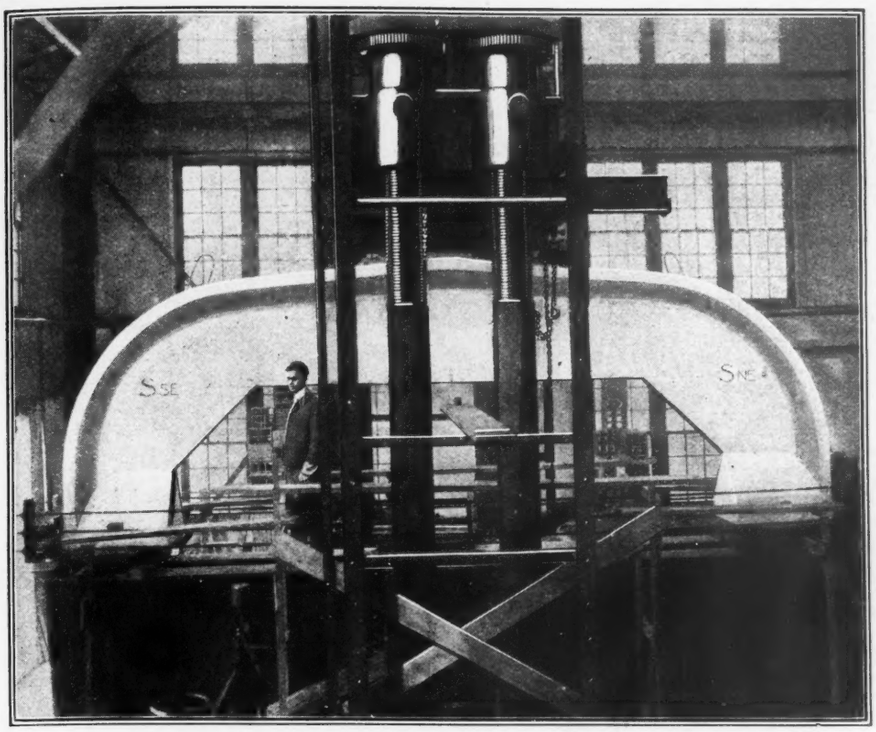
The hull is only one part of the job; for, when that is finished, the machinery and fittings must be installed. This is done in the usual way, except that the fittings are fastened to the concrete by means of bolts that are put in place when the concrete is poured, or through "sleeves" provided for the purpose.



One of our new concrete ships being built. This shows the arrangement of the mesh-and-steel reinforcement before the concrete is poured in the molds

To Protect It from Sea Water

The hull must be covered to prevent the sea water from penetrating to the concrete and the steel framework. A new coating is now being used to give the needed protection against



The largest testing machine in the world, at the Bureau of Standards, Pittsburgh. It is shown testing a reinforced concrete beam 23 feet long and 8 feet 2 inches high, representative of a section of a concrete ship at cross-rib

both the action of sea water and the growth of marine parasites. In the opinion of Mr. Wig, the danger to the hull from these causes has been obviated. He stated recently:

"From our comprehensive tests of concrete structures at sea water, we are convinced that concrete ships will last a minimum of several years without any protection whatever. By the application of protective coatings which are well known to us, we are certain of an extended life of several years additional, and with the further developments of protective means upon which we are now working, I believe the concrete ship can be made as permanent as steel, if not more so."

Concrete ships are not launched end on, as is the usual way. They are launched sidewise, because the stresses caused by the sidewise launching are considered to be much less than those incident to an end-on launching. Another reason for this method of launching is that the ship can be constructed on an even keel with all the vertical lines truly vertical.

The concrete shell is from three to six inches in thickness. In a ship of 3,500 tons dead - weight carrying capacity, the bottom is five inches thick, the side walls and deck four inches thick. The shell is reinforced by a network of bars running both up and down. The bars are so placed that there is a protection of from five eighths of an inch to one inch between the bar and the outside of the concrete.

How the Ships Are Reinforced

The reason for the reinforcement is that a ship is subjected to severe stresses when it is on the ocean. Concrete is very strong in resisting compressive stresses, but very weak in resisting tensile stresses. Therefore the concrete in the ship is reinforced with steel because steel has a high tensile strength. Steel bars are placed in the concrete in such a manner that they will take up the tensile stresses.

Steel bars are used also to help the concrete to withstand the compressive stresses. For example, they are placed in the top and bottom of the concrete ribs and are bound together by steel bands. In this way is built a ship that combines the ability of steel to withstand tensile stresses with the ability of concrete to withstand compressive stresses.

"Hogging" and "Sagging"

When you take into consideration exactly what happens to a ship traveling on the sea, you will perceive the wisdom of this construction. The ship is subjected to severe longitudinal stresses, due to the action of the waves. It is alternately supported by a wave-crest amidships, with the ends of the ship in troughs, known as "hogging," and then supported by wave-crests under the ends of the ship and a trough amidships, called "sagging."

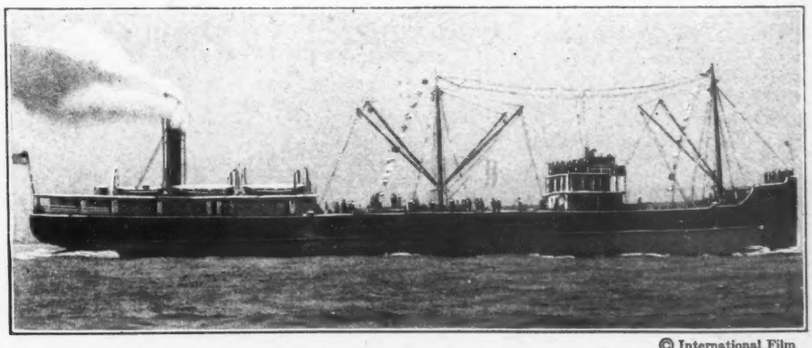
In "hogging," when the support is amidships, the deck of the ship is subjected to tension and the bottom to compression. Under "sagging" the reverse takes place: the deck is under compression and the bottom is under tension. In a steel ship, the plating of the deck, bottom, and sides is relied upon to take up these stresses. Therefore sufficient steel reinforcement is placed in the deck and the bottom of a concrete ship to take up the tensile stresses and to assist in withstanding the compressive stresses.

So far, it has not been possible to make concrete ships as light as steel ships, but every effort is being made to produce a concrete mixture that will be much lighter in weight than either broken stone or gravel. When this has been accomplished, it will be possible to build concrete ships that will be nearer the weight of steel ships.

Not as Light as Steel

Even though concrete ships are not made as light as steel ships, they can compete commercially with steel ships, because it costs less to build them. It is estimated that it costs about one hundred and twenty-five dollars a dead-weight ton to build concrete ships, while steel ships cost two hundred dollars a dead-weight ton.

Another advantage in building concrete ships lies in the fact that, excepting the small amount of steel used in the reinforcement, it is possible to build the hull without calling upon any of the trades or industries that are required in ordinary ship construction.



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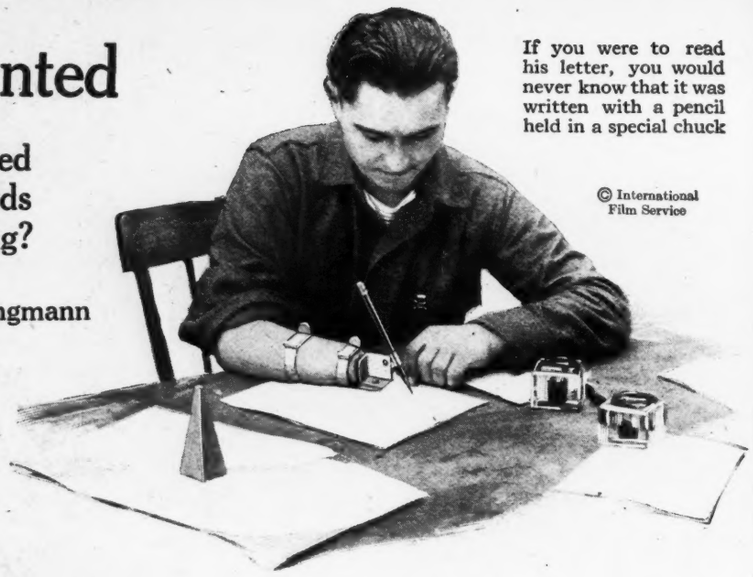
The *Faith*, largest concrete ship afloat. She was launched on March 14, 1918, and has been plying the waters of the Pacific so successfully that all doubt of the seaworthiness of concrete ships has vanished

Crippled But Undaunted

Which shall it be for the crippled veteran of thirty—playing cards in a home or earning his living?

By Waldemar Kaempffert and A. M. Jungmann



If you were to read his letter, you would never know that it was written with a pencil held in a special chuck

© International Film Service

IN one of the battles of the Boer War, Piper Findlater, a Scotch Highlander, had his legs shot off. He lay on the ground, a bleeding wreck of a man, clutching his bagpipes and playing "The Cock o' the North." A whole regiment was fired by the man's grit. The next day Findlater's name was on every lip; newspapers and magazines made much of him; music-hall ditties typified him as the stuff of which Britain's army is made. He was the hero of the hour, and deservedly so.

After that hour had passed, and the decorations that had been pinned on Findlater's breast had begun to tarnish, the legless hero who cheered on his regiment dropped completely out of sight.

But England was destined to hear of him again. His name reappeared—this time on the posters of music-halls; he was to play his bagpipes, sandwiched in between the trained seals and the Japanese acrobats.

England was horrified—not at itself, but at Findlater. No one stopped to investigate the social and economic conditions that compelled poor Findlater to make a living in a field which he had probably never dreamed of entering. Instead of holding out a tin cup on a street corner, he was doing his best to earn an honorable living, and to relieve the State of caring for him.

Yes, they even box

Forty Thousand Cripples Out of an Army of a Million

Peace is not yet in sight, but already every government has seen to it that there shall be none of the thoughtlessness that marked the return of Findlater to private life. The privilege of selling shoestrings on the streets of New York or Chicago after having been blinded by German gas or having an arm torn off by a German shell—is that to be the reward of fighting for democracy? Or to watch the flies buzzing against the panes of some whitewashed home at the age of twenty-five or thirty? Or to gaze on the world as if one were no longer a part of it?

Until the war is ended the total number of men to be provided for is a matter of mere estimate. If we use the word "disabled" in its broadest possible sense, we may expect the return of 120,000 for each million men sent overseas.

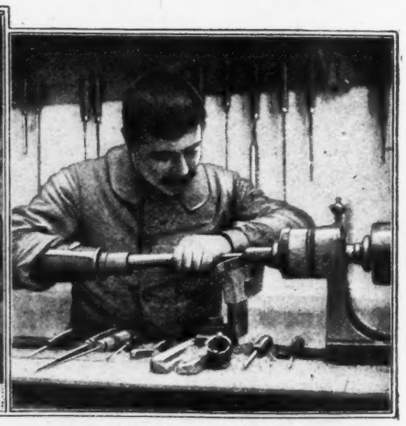
It is unthinkable that these men shall be permitted to become objects of a demoralizing charity. And so, following the example set by France and England, this country has laid its plans to preserve the self-respect of men who will return to us blind, legless, armless, and otherwise handicapped. The Red Cross Institute, the Federal Board for Vocational Education, the Surgeon-General's office, and various societies and industrial firms will see to it that there shall be no Piper Findlaters.

Federal Board for Vocational Education

Since fully 80 per cent of the disabled will be capable of earning a livelihood, according to Major J. L. Todd, a medical officer connected with the Board of Pension Commissioners of Canada, it will be no light task to find places for

Here is an example of what the chuck will enable a man to do

Ping-pong for the armless! Who could have foreseen that at the outbreak of the war?



An artificial arm should be made, not for looks, but for service

No doorkeeper's or watchman's job for him. He wears the chuck type of arm, made to receive different tools

It is easier to design a leg than an arm; after all, it is used simply for the purpose of support

"Fine," said Thomas A. Edison, on learning how this man with one arm and leg earns a living

men who are still young and who have been taught to make the most of the physical equipment that still remains. In addition to the thousands of amputation cases with which the United States must deal, it must also make some provision for tens of thousands of men afflicted with severe rheumatism, paralysis, shattered muscles, stiff joints.

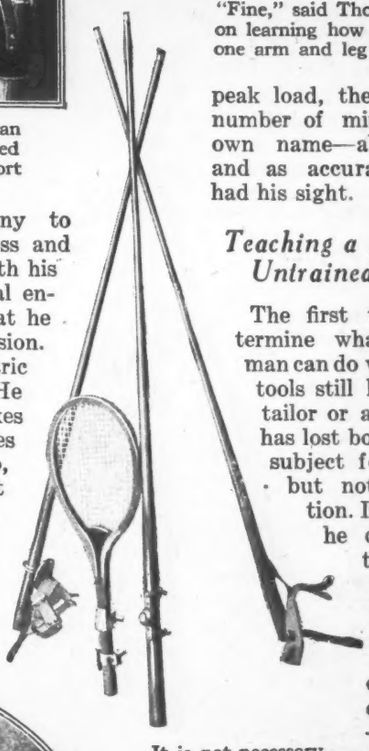
On the Surgeon-General of the United States Army will devolve the duty of healing the disabled man and of giving him some preliminary training. Then he passes to the jurisdiction of the Federal Board for Vocational Education. He will earn something while he is learning a trade anew, and a family allowance will be paid. When he has completed the prescribed course, he will be turned over to some accredited organization, which will see to it that he finds employment at the trade that he has learned. No man is compelled to attend a re-education school, but his pride will be deliberately touched, so that he will have no desire to become an object of sympathy or charity.

Some Men Who Have Been Re-educated

How does this work out in practice? Lieutenant Frederick Holmes, Ontario officer in charge of Industrial Surveys, recently wrote of a Canadian who had lost one eye and both legs, and who was turned over to a jewelry house for a course in silver-polishing. In six months the man was not only an expert silver-polisher, but had also learned gilding and soldering.

Then there is the case of Captain Edward Baker, who went with the 4th Canadian Field Company to France, won the Military Cross and the Croix de Guerre, and lost both his eyes. He had been an electrical engineer, but was so disabled that he could not practise his profession.

His old firm—a hydro-electric company—took him back. He now operates a typewriter, takes trouble reports along the lines between Niagara and Ontario, makes out reports on a sheet of paper with twelve rulings, and, by an ingenious spacing arrangement invented by himself, typewrites in the proper space the date, time of day, the trouble, the peak load, the low load, the number of minutes, and his own name—all as quickly and as accurately as if he had his sight.



It is not necessary for a man, because he is a cripple, to give up tennis and other sports

France re-educated him and showed him how he could work his farm

Teaching a Man to Use Untrained Muscles

The first task is to determine what a disabled man can do with the natural tools still left to him. A tailor or a novelist who has lost both his legs is a subject for sympathy, but not for re-education. If a man is blind, he does not have to content himself with becoming either a piano-tuner or a weaver of baskets and chair bottoms—the traditional occupations of the sightless. A hundred callings are open to him—winding the wire on induction coils and armatures, assembling airplanes and parts of automobiles, feeding material to automatic machines.

If he has lost his right arm, he is taught how to use his left. Even if both arms are gone his case is not industrially hopeless: with the aid of appliances, he may still hold his own in competition with an able-bodied man. A hand is a tool—one of the most wonderful, versatile, complicated tools that

© International Film Service

There are dozens of ways of moving the spacing-bar of a typewriter. This man uses a string attached to a cam mechanism

© Publishers' Photo Service

The machine must sometimes be adapted to the man. Here is one cripple's way of working the space-bar of a typewriter

nature has devised. Study it. Bend and stiffen its five fingers, and you have a powerful claw. Clench the fist and you have a hammer. With the aid of the thumb you can form a pair of pincers with any one of four fingers. The arm is a lever by means of which this marvelous tool is moved to a place indicated by the brain. The invention of a serviceable substitute arm and hand is a far more difficult problem than the invention of a leg.

Remarkable results have been obtained by fitting to an arm-stump special appliances to be used for special purposes. Thus a chuck may be attached to the stump in which a knife, fork, spoon, or tool can be interchangeably inserted. For some special cases, devices must be invented which the cripple may attach to parts of his body, not to take the place of missing limbs, but to serve as new ones. A ring or loop is attached to the suspenders or belt to assist a one-armed man to handle a shovel; or yokes, special belts, and grasping devices are operated by pressure of the body against the work-bench; or a "third thumb" holds a magnifying-glass.

How the Disabled Will Be Re-educated

What is the process of restoring a crippled soldier to a living? First of all, the hospital surgeon must heal the man, so far as that is possible—loosen his stiff joints, soften his scars. Occupation is one of the best agents that the surgeon has at his disposal.

When the surgeon has done all that can be asked of his skill, the patient is ready for vocational guidance. He receives free a leg or an

© Publishers' Photo Service

How it looks from the front

arm—sometimes two legs or two arms. The arms are implements and not deceptions. They are intended to serve a man in earning his living, not to trick the community into believing that he is whole. Just as the natural arm is a tool manipulated by a wonderful system of levers, joints, and tendons, so the artificial arm is an artificial set of muscles—steel wires, rawhide cords: the whole linked up to form a new muscular combination with which the man must familiarize himself. It is amazing what can be accomplished with such substitutes.

Since the hook and the clamp are the most useful of all devices, it is no difficult matter to provide a useful artificial hand which consists of nothing more. Only when the necessity of providing a tool is considered, regardless of its appearance, is real mechanical success attained. The simplest form of artificial hand is one so constructed that the fingers are bent in a fixed position to form a hook, and the thumb is made to move against them to form a clamp. A spring gives the thumb grasping power enough to clutch small objects. If large objects are to be seized, some form of locking device must be provided, since grasping power is limited by the spring.

For Use, Not for Show

Indeed, the modification and combinations of the hook and clamp are almost numberless. Perhaps the most useful of all is a combination of two fingers with a thumb—the fingers fixed and the thumb moving between them. Open the hand and you have a hook; close it and you have a means of holding nearly all ordinary tools.

If drawing-room considerations must be abandoned to help the one-armed, they are even less significant in restoring the armless to a place in the industrial world. Here the best plan seems to be that of adapting the mechanism provided to the particular kind of work to be performed. With the aid of a strap or two, for example, a man can dress and feed himself. The simplest devices, aided by perseverance and intelligence, accomplish wonders. The old-fashioned "peg-leg" and the simple hook and claw are by far the

Legless but undaunted

most popular contrivances still, despite all the thought that engineers have given to the problem of the crippled soldier.

Long before the United States entered the war, Frank B. Gilbreth, the American efficiency engineer and motion-study expert, gave much thought to the problem of the crippled soldier, partly through humanitarian motives, partly at the request of European governments. Mr. Gilbreth demonstrated that it is possible for a cripple to adapt himself to specified work, if the motions required to perform that work are analyzed and tabulated in proper sequence. Slight changes in machines enable many a cripple to practise his old calling.

Adapting Tools to Cripples

Gilbreth has accomplished marvels in adapting the typewriter, for example, to the needs of the armless. He has shown how a legless man can travel from machine to machine in a shop on a little seat running on a track; he has demonstrated that a one-eyed, one-armed man can practise dentistry, if his patients will but assist him by holding down gums. He has pointed out the necessity of training cripples for the work in which they themselves are most interested, and of teaching the public what attitude should be assumed toward the crippled. He would show the cripple how to adapt himself to existing vocations, so that he will actually compete with an able-bodied worker; would create entirely new occupations where that may be necessary; and, lastly, would reserve certain places for cripples. Gilbreth maintains:

This hammer has been invented for one-armed cripples. On pressing the trigger with the forefinger, a nail drops from the magazine, to be carried to the proper place until it is driven in place by a blow. When the finger is removed from the trigger, the holder drops back, and leaves the hammer free to finish driving in the nail

Every one of us is in some degree a cripple, either through being actually maimed or through having some power or faculty which has not been developed or used to its fullest extent. . . . From an efficiency standpoint, a policeman with corns on his feet, or a golfer with gout in his toe, is more of a cripple during his working hours than a legless man while operating a typewriter. We can then think of every member of the community as having been a cripple, as being a cripple, or as a potential cripple.

Nearly all of us are one-armed in the sense that we use the right arm almost exclusively; the left is merely an auxiliary used as a weight to hold a sheet of paper or a piece of work. That simplifies the re-education of those who have lost a left hand or arm enormously. And if the right is lost, the left is trained to acquire its functions. Indeed, it is by no means unusual for a one-armed man to discard all artificial aid. The remaining stump serves to hold down the piece of work.

The Future in Industry

No past war has ever made such demands on populations as this. While, therefore, we may be prosecuting this war with more foresight than our fathers showed, we must not forget that the very character of the conflict compels the exercise of generalship in industry as well as on the battlefield. Past wars did not cripple men by tens of thousands.

The men who will return from France sightless and maimed will constitute a veritable army. For that reason, the warring countries have made it their business, even while cannon are still belching death, to give back to the crippled veteran his place in the world.

Frank Gilbreth, the motion-study expert, sent us this picture to show what persistence can accomplish

At twenty-three this man became a cripple from rheumatism. He learned the machinist's trade, and is now employed by a big typewriting concern

After all, anybody can brush one hand at a time. We must use the tools that nature has given us

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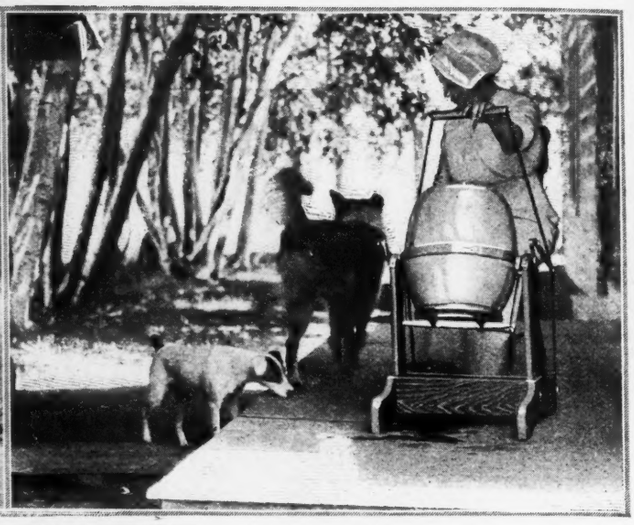
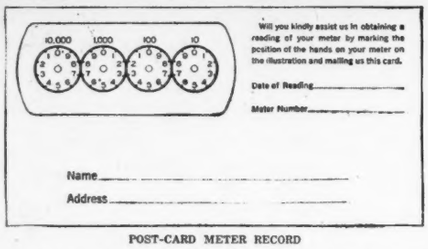


Peanut Wagon Remodeled into Street Floral Shop

WHEN the price of peanuts advanced to such a figure that the business became unprofitable, James Carlton, of Urbana, Ill., remodeled his peanut wagon into a street floral shop. He now sells ferns, geraniums, tomato plants, and similar products in demand by home gardeners. Large quantity orders are solicited on the downtown streets from a few samples carried in the former peanut wagon, and the order is filled from Mr. Carlton's back-yard garden.

The tank on top of the wagon which once supplied the gasoline for roasting popcorn is now filled with water, which is conveyed to the plants by a hose.


10,000
1,000
100
10
Will you kindly assist us in obtaining a reading of your meter by marking the position of the hands on your meter on the illustration and mailing us this card.
Date of Reading
Meter Number
Name
Address

POST-CARD METER RECORD

Meter Readings by Post-Card

THE Twin State Gas-Electric Company of Brattleboro, Vt., has adopted a new method for avoiding delays in keeping records and making out monthly bills in cases where customers were absent when the meter reader made his monthly call. If the meter reader finds that he cannot get into the house, he slips an addressed post-card under the door.

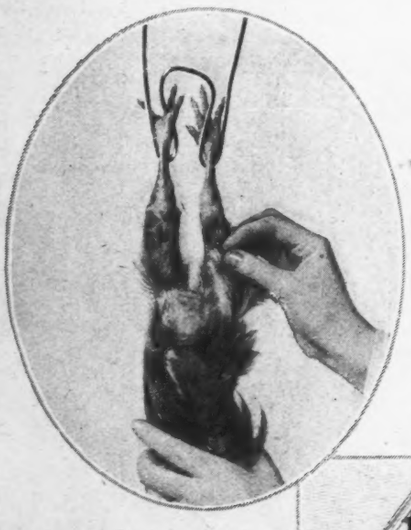
This card requests the customer to mark the position of the dial hands of the meter on the card and mail it to the company.

A Barrel-Shaped Germ-Proof Churn of Stoneware

THERE are many churns in the market which, when new, are sanitary, but which soon become unsanitary because they cannot be kept clean.

The churn shown in the picture above does not belong to this class. The barrel-shaped body is of glazed stoneware. Its surface and lining will not absorb any injurious matter and can be perfectly cleaned.

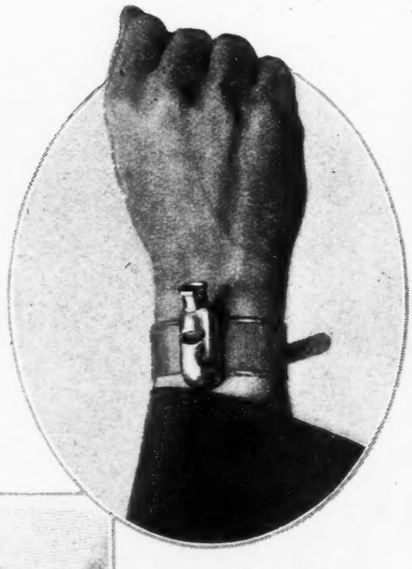
This churn is suspended from the uprights of a framework or stand resting on wheels, and is revolved by a simple crank mechanism driven by hand or by power.



How a Bridge Gave Way to a Steamer

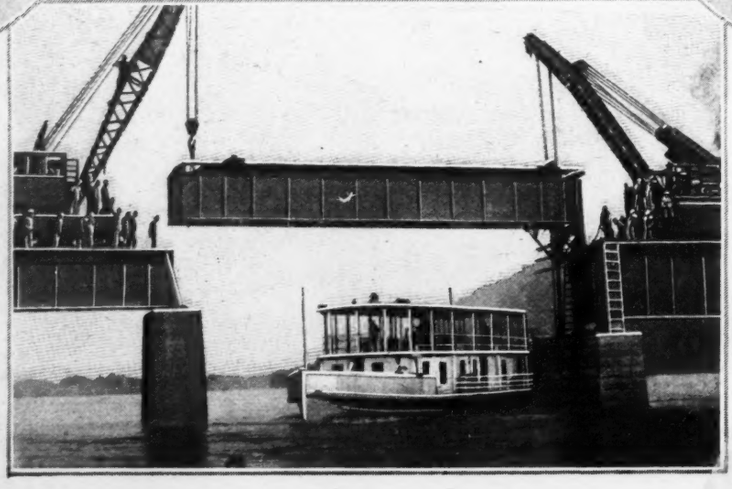
THE Wisconsin river, which flows into the Mississippi at Prairie du Chien, Wis., was once a great commercial highway. When the stream became blocked with sand-bars, river navigation was gradually abandoned, and the Burlington Railroad built a bridge across the river at Prairie du Chien.

Meanwhile a St. Louis company built a steamer and brought it down the Wisconsin. The status of the Wisconsin as a navigable stream made it necessary for the railroad company to raise a section of the bridge while the steamer passed under.



For Plucking Fowl

A CONVENIENT device for holding a chicken or other fowl for plucking can be made without tools and at a trifling expense from a piece of heavy wire. The wire is bent into the shape of a capital "W," with the lower loops just large and close enough to catch and hold the legs of the suspended fowl, above the spread of the toes. The two ends of the wire are bent in the form of a hook to fit over a nail or other convenient support.



Not a Wrist-Watch

THE functions of wrists increase daily. A few years ago a wrist's only duty was to join hand to arm. Then it became the bearer of watches, and now it carries whistles.

A California police sergeant has invented the wrist whistle here illustrated. The whistle has a keeper on its under side through which the wrist-band is passed. The lip-piece is directed angularly upward to make its use more convenient.

A 46-Inch Horse in a 36-Inch Manhole

ONE of the most unusual accidents happened in a city in New York State recently, when a horse 42 inches in diameter at the widest part kicked off a manhole cover and slid down the manhole, which measured only 36 inches. The horse dropped down to the bottom of the manhole, ten feet below, leaving only his front feet visible.

The owners at first doubted whether they could rescue the animal alive; but they got hold of a wagon with a derrick having a swinging boom, and attached the tackle to the front legs of the horse just above the hoofs, as shown in the picture below. Then the winch was set running, and the horse came out head first.

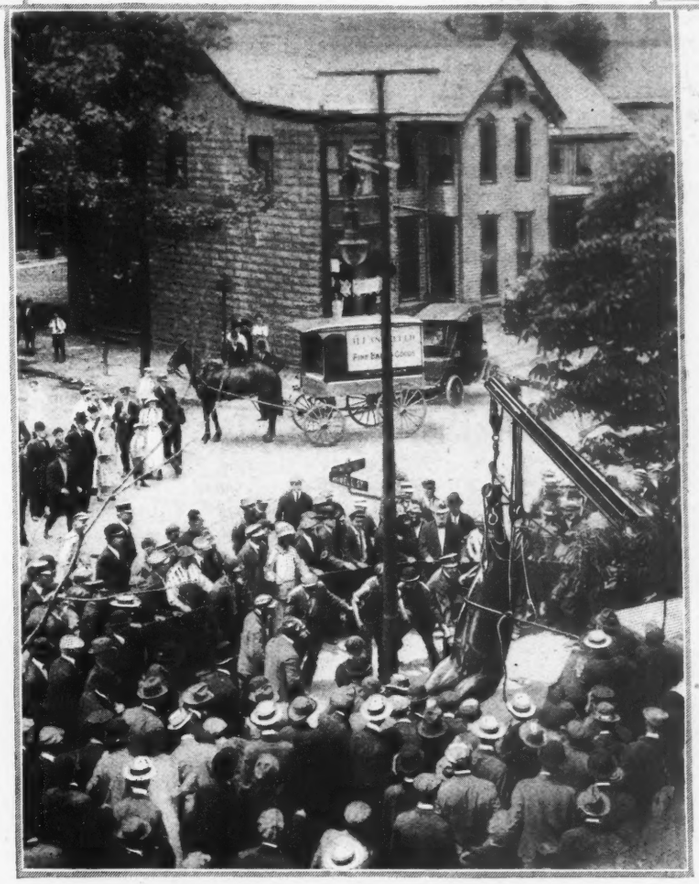
To the surprise of the spectators, the horse got up and walked away as soon as the tackle was removed.

An Adjustable Golf Rim Cup

BY means of an adjustable golf rim cup recently placed on the market, the terminal point on each green is made a lodging-place for the ball rather than for water and earthy deposits.

By means of a sort of wrench and a screw on the lower part of the cup, the rim may be raised or lowered so as to be always level with the top of the ground, while a space beneath takes care of water and earth which filters in, leaving the cup proper always clean.

The cup itself is about five inches long. The wrench with which the cup is turned is light and readily inserted or detached. After once being put in place, such cups require no other attention than occasional adjustment, and as they are set exactly even with the surface, they do not in the least interfere with the grass-cutting machines.



A Cartridge that Carries Light

USUALLY bullets are messengers of death. The one shown above carries light into dark places. It is merely the now familiar electric torch in a war-time setting, the cartridge form lending itself easily to the purposes of the torch-maker.

Instead of powder and bullet, the case contains an electric battery and a lens. Where the stroke of the firing-pin in a rifle fires the real cartridge, a pressure of the finger brings forth a beam of light from the flashlight masquerading in cartridge form. Perhaps, if used by a burglar-hunting householder, it would impress the intruder as a gentle hint of what might follow his discovery, and thus doubly armed no one should be afraid to go home in the dark.

Either end of the flashlight may be screwed off, one for renewing the battery and the other for adjusting the lens or bulb. The bullet end is handsomely nickeled to add to the appearance of a shell and bullet.

The "Speeder"—a Joy for the Modern Youngster

THE youngster who is driven to such straits that he attempts to make for himself a speeder or scooter, which he can hold in an upright position, will appreciate the worth of the device shown in the photograph (*left*). One foot is placed on the carriage; the other is used to propel the speeder; at the same time the handle held in either the right or the left hand keeps the device in the proper position and gives the user control over it. The speeder may be used by both boys and girls.

"Loop-the-Loop" Glider for Boys and Girls

THERE is great fun for both boys and girls in the "loop-the-loop" glider, which sails for over two hundred feet straightaway, or, when properly adjusted, loops the loop in true Beachey fashion and then sails on again. The user, after a little practice, can control the flight of the glider with reasonable accuracy.

The motive power is furnished by a sling with a rubber band. The wings and rudder are of stiff cardboard. The planes are held rigidly in place by wire springs. No nails or rivets are needed. The owner can assemble it in a minute or two.

Battling in a Tank

By Captain Richard Haigh, M.C., *Commander of the Tank Britannia*

In the dozens of books in which men of all ranks have recounted their experiences in training and in battle, we have found nothing more graphic and technically more instructive than this description of a tank in battle, from Captain Richard Haigh's "Life in a Tank." By permission of Houghton, Mifflin Company.—The Editor

WE all looked round the little chamber with eager curiosity. Our first thought was that seven men and an officer could never do any work in such a little place as this.

In front are two stiff seats, one for the officer and one for the driver. Two narrow slits serve as portholes through which to look ahead. In front of the officer is a map-board and gun mounting. Behind the engine, one on each side, are the secondary gears. Down the middle of the tank is the powerful petrol engine, part of it covered with a hood, and along either side of it a narrow passage. There are four gun turrets, two on each side. There is also a place for a gun in the rear.

Electric bulbs light the interior. Beside the driver are the engine levers. Behind the engine are the secondary gears, by which the machine is turned in any direction. All action inside is directed by signals, for when the tank moves the noise is such as to drown a man's voice.

Locked in a Steel Box

Supposing you were locked in a steel box, with neither portholes to look through nor airholes to breathe from. Suppose you felt the steel box begin to move, and, of course, were unable to see where you were going. Can you imagine the sensation? Then you can guess the feelings of the men in a tank—except the officer and driver, who can see ahead through their portholes—when the monster gets under way.

One day we received word that an attack was to come off the next morning. At this part of the Hindenburg line it was very easy to lose one's way, especially at night. The tanks were scheduled to start moving up at ten o'clock. Talbot and the Old Bird, with several men, set out at eight—to arrange for marks to guide the machines.

The attack was timed to come off at dawn. McKnutt's machine was the first to start, an hour earlier.

"Cheero, McKnutt," we said, as he clambered in. "Good luck!"

The men followed, some through the top and some through the side. The doors and portholes were closed, and the tank crawled forward.

On the Edge of Death

She had about fifteen hundred yards to go, parallel with the Hindenburg line, and there were several trenches to cross before she would come up with the enemy.

Since it was still dark and the attack had not commenced, McKnutt and his first driver opened the windows in front of them. They looked out into impenetrable gloom.

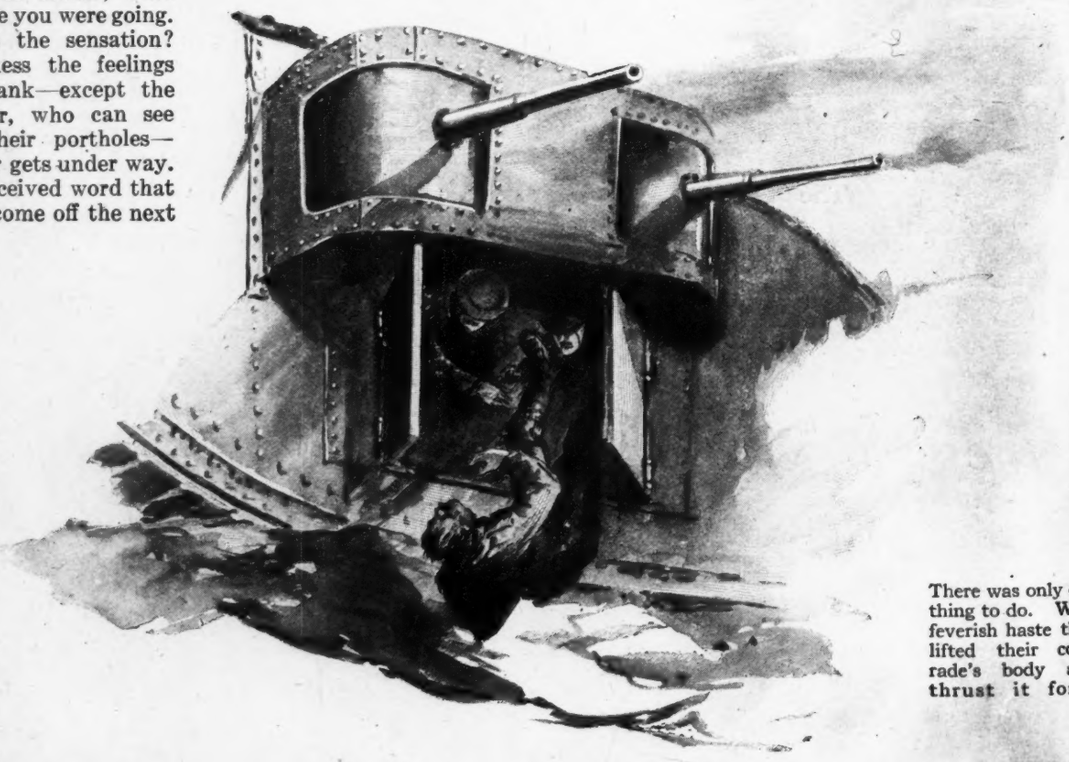
Their route ran close to the sides of an old quarry and they edged along cautiously. McKnutt, with his eyes glued to the front, decided that they must have already passed the end of the quarry. That would mean that they were not far from the spot where they were to wait for the signal to go into action. The moon had again disappeared behind the clouds.

Suddenly McKnutt's heart took a great dive and he seemed to stop breathing. He felt the tank balance ever so slightly. Staring with aching eyes through the portholes, he saw that they were on the edge of the old quarry, with a forty-foot drop down its steep sides before them. The black depth seemed bottomless. The tank was slipping over. When she shot down they would all be killed.

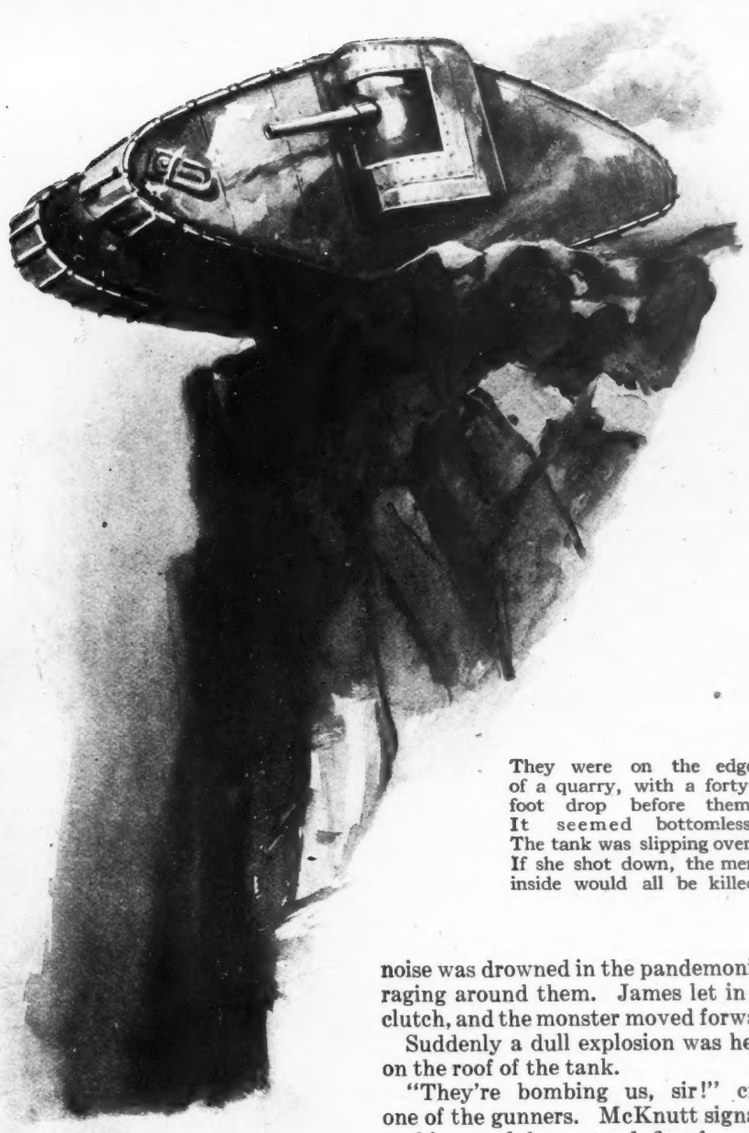
But the driver kept his head. As the tail of the tank started tipping up, he managed somehow with the brakes to hold her on the edge. For a second or two, she swayed there. She seemed to be unable to decide whether to kill them or not. The brakes would not hold them for long.

The Men Never Knew

Then the driver acted. Slowly he put his gears in reverse, keeping the brake on hard until the engine had taken up the strain. Slowly she moved back until her tail bumped on the ground. Neither McKnutt nor his driver spoke. They pushed back their tin hats and wiped their foreheads.



There was only one thing to do. With feverish haste they lifted their comrade's body and thrust it forth



They were on the edge of a quarry, with a forty-foot drop before them. It seemed bottomless. The tank was slipping over. If she shot down, the men inside would all be killed

McKnutt glanced back at the men in the rear of the tank. They, of course, had been unable to see out, and had no idea of what they had escaped.

They settled down now to a snail's pace, shutting off their engine, as the Germans could not be more than one hundred and fifty or two hundred yards away.

The heat inside the tank was oppressive. McKnutt and James opened the top, and crawled out, the men following. They looked around. The first streaks of light were beginning to show in the sky. A heavy silence hung over everything—the silence that always precedes a bombardment.

Slowly the minute-hand crept round to the half-hour, and the men slipped back into their steel home. Doors were bolted and portholes shut. The engine was ready to start.

"Start her up!" yelled McKnutt.

But the engine would not fire.

"What the devil's the matter?" cried James.

A bit of tinkering with the carburetor, and the engine purred softly. Its noise was drowned in the pandemonium raging around them. James let in the clutch, and the monster moved forward.

Suddenly a dull explosion was heard on the roof of the tank.

"They're bombing us, sir!" cried one of the gunners. McKnutt signaled to him, and he opened fire from his sponson. They plunged along, amid a hail of bullets.

McKnutt and James, with that instinctive sense of direction which comes to men who control these machines, felt that they were hovering on the edge of the German trench. Then a sudden flash from the explosion of a huge shell lit up the ground around them, and they saw four or five gray-clad figures, about ten yards away, standing on the parapet, hysterically hurling bombs at the machine.

Bombs Seem Like Pebbles

They might as well have been throwing pebbles. Scornfully the tank slid over into the wide trench and landed with a crash in the bottom. The Germans thought she was stuck. They came running up. But they never reached her, for at once the guns from both sides opened fire.

The huge machine dragged herself up the steep ten-foot side of the trench. As she neared the top, it seemed as if the engine would not take the final pull. James took out his clutch, put his brake on hard, and raced the engine. Then, letting the clutch in with a jerk, the tank pulled herself right on to the point of balance, and tipped slowly over what had been the parapet of the German position.

Now she was in the wire that lay in front of the trench. McKnutt signaled back, "Swing round to the left." A moment's pause, and she moved forward, relentlessly crushing everything in her path, and sending out a stream of bullets from every turret.

At the same time, our own troops, who had waited behind the barricade to bomb their way down from traverse to traverse, rushed over the heap of sand-bags, tangled wire, wood, and dead men which barred their way. But the tank crew could not see them. The corporal touched McKnutt on the arm.

"I don't believe our people are keeping up with us, sir," he said. "They seem to have been stopped about thirty yards back."

"All right," McKnutt answered. "We'll turn round."

McKnutt and James opened their portholes to obtain a clearer view. Five yards along to the left, a group of Germans were holding up the advancing British. They had evidently prepared a barricade in case of a possible bombing attack on our part, and this obstacle, together with a fusillade of bombs which met them, prevented our troops from pushing on. McKnutt seized his gun and pushed it through the mounting, but found that he could not swing round far enough to get an aim on the enemy. But James was in a better position. He picked the gray figures off, one by one, until the bombing ceased.

The Enemy Gets a Gunner

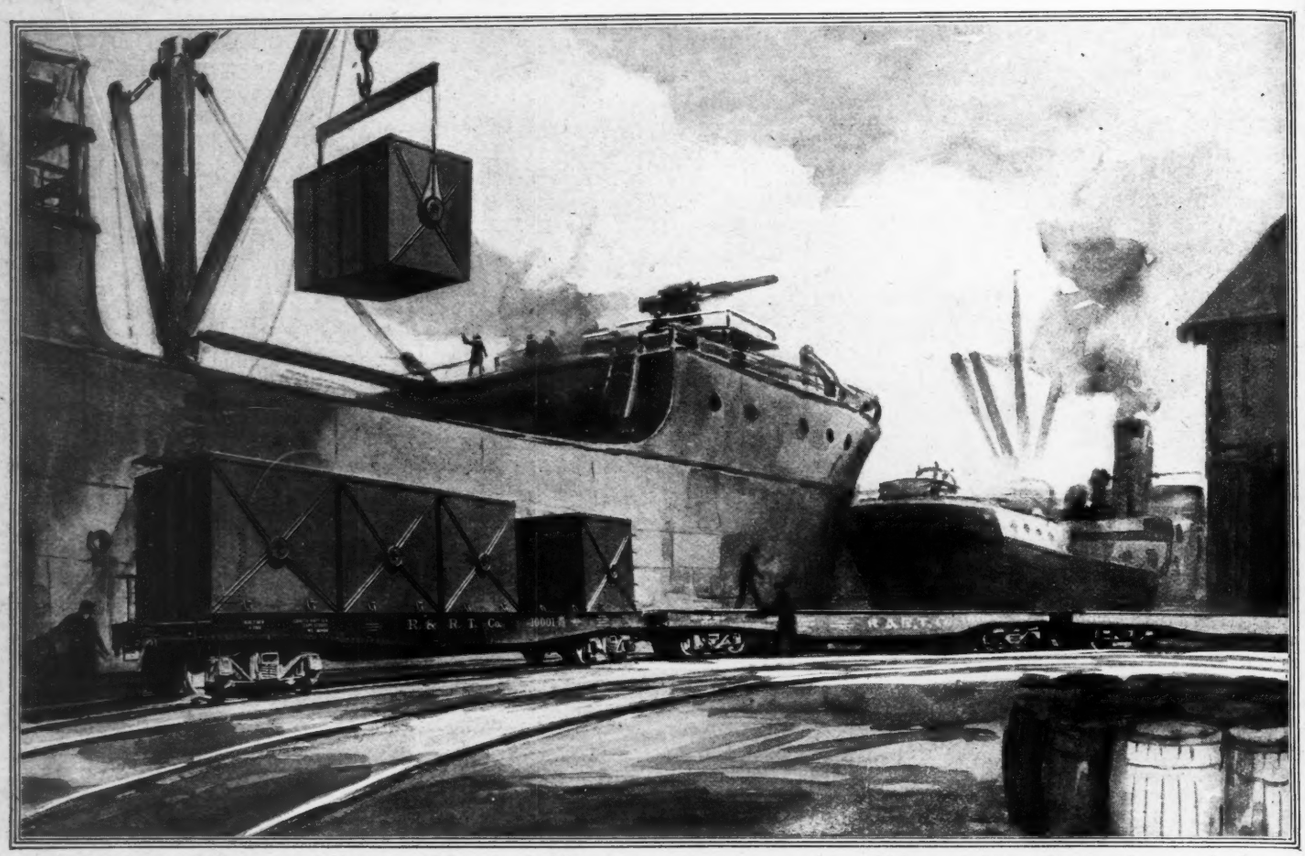
Then a sudden and unexplainable sense of disaster caused McKnutt to look round. One of his gunners lay quite still on the floor of the tank, a stream of blood trickling down his face. The corporal who stood next to him pointed to the sights in the turret and then to his forehead, and McKnutt realized that a bullet must have slipped in through the small space, and entered the man's head.

He lay along one side of the tank, between the engine and the sponson. The corporal tried to get in position to carry on firing with his own gun, but the dead body impeded his movements.

There was only one thing to do. The corporal dragged the body and propped it up against the door. Immediately the door flew open. With feverish haste they lifted the body and threw it out.

With daylight the enemy realized the futility of his efforts, and the tank went back to the Allies' lines.

Ways to Make the Freight-Car Do More Work



The freight-car has reduced the cost of long-haul shipments; but delays in loading and unloading mean heavy money losses, so that the cost of living goes up. A St. Louis engineer, Kirchner, advocates a car in which a skeleton framework on wheels carries a number of box-like sections which can be loaded and unloaded in a few moments by means of electric cranes

FEW people realize that approximately twenty cents out of every dollar they spend for things to eat, wear, and use goes for freight. Nor do they realize that in the case of perishable goods (milk, ice, etc.) the cost of transportation from the point of origin to the final consumer is often as much as fifty cents for each dollar spent.

But what are we going to do about it?

Government Eliminates Some Evils

The government has taken over the railroads, and has eradicated many of the evils. No longer, for instance, will cars be held as warehouses for excessively long periods at ridiculously low charges; no longer will cars be loaded to only one quarter capacity in order to meet a similar service in next-day delivery by a competing line.

But all these steps toward efficiency do not solve the problem, according to a St. Louis engineer named Kirchner, because they have not utilized freight-cars to the utmost. Whenever a freight-car stops moving, it becomes merely an expensive warehouse; the expensive car framework of the platform, axles, wheels, bumpers, air-brakes, and other devices cease to serve a useful purpose.

All this is true because muscle instead of machine power is used to unload a very large percentage of box-cars.

The yearly freight-car mileage is only eight thousand. This means that a freight-car moves only about twenty-two miles a day, although the average speed of a freight train is thirty miles an hour. Even at an average speed of only twenty miles an hour, and with only twelve hours in motion daily, the possible mileage is 240. Why the difference between the actual mileage of only twenty-two miles and the possible figure of 240? Because the vehicle part of the car is idle while the body is being unloaded.

Suggestion for a New Style Car

In order to overcome the difficulty, when either full carload lots or less than carload lots are shipped, Mr. Kirchner would have the railroads employ a car in which a skeleton framework mounting the wheels, axle, and all movement parts carried a number of rectangular box-like steel sections, which could be loaded and unloaded from the car at each stop in a few moments' time by means of an electric crane.

The sections are made in two main sizes, called the primary and secondary units. Five of the primary units, each of ten tons load capacity, go to make up the equipment of a 100,000-pound capacity freight-car. The secondary units are of two and one half tons capacity each, and twenty of them are carried on one car to make up the same fifty-ton capacity. The primary units are for through freight, while the secondary units are for local freight.

Some of the Advantages

The secondary units may be used to carry still smaller units of from six to eight hundred pounds capacity, the latter units being so designed as to fit exactly inside of the secondary unit in much the same manner as a child's set of wood blocks fits into its outside box. All of the units are made of steel from three sixteenths to a quarter of an inch thick, and are made water-, air-, and weather-proof, so that the goods contained in them cannot spoil. To prove this contention, two of the boxes were filled with two different classes of materials, one with flour and one with sugar, and left to stand in the open air for two years. When opened the contents were in perfect condition.

The advantages claimed for the method of shipping in units are that

it would provide for greatly increased car mileage, resulting in increased car profits and decreased rates to the shipper; it would save back hauls of empties; it would practically eliminate demurrage charges; it would save the cost of handling and the cost of crating goods; it would save on insurance to cover breakage, since all the units are of steel; and it would eliminate the shoveling of coal or other bulk materials for loading or unloading.

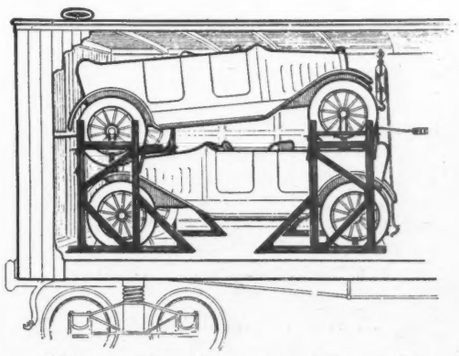
A Typical Case

Suppose a farmer is threshing wheat. With the unit method he will get some of the small secondary units, haul them to his farm, load them with the wheat, and then haul them back to the nearest rail station, where they will be placed in one of the primary units and sent along to their destination in the first car that stops. They will go at the carload rate, too, since the car will be carrying a full load in the other units. No bags, boxes, or barrels have been used by the farmer, and he has not had to stand any loss for wasted grain, which on the average amounts to eight bushels for every thousand bushels shipped.

Or, in the case of the wholesaler shipping to the retailer, the wholesaler gets an order for a certain quantity of canned goods, tomatoes, soups, peas, pears, etc., or a mixed order for groceries, which are packed into one of the secondary units and the unit sent to the retailer, who shelves the goods and returns the unit to the nearest agent in exactly the same manner as the Standard Oil Company has its barrels returned.

For shipping wagons, automobiles, or heavy pieces of machinery, the compartment freight-car is obviously impracticable.

The railroad loading and shipping deck placed on the market by a Western manufacturing concern offers a solution of the economy problem in such cases by providing a method of loading automobiles or other large pieces of freight on two decks, one above the other.



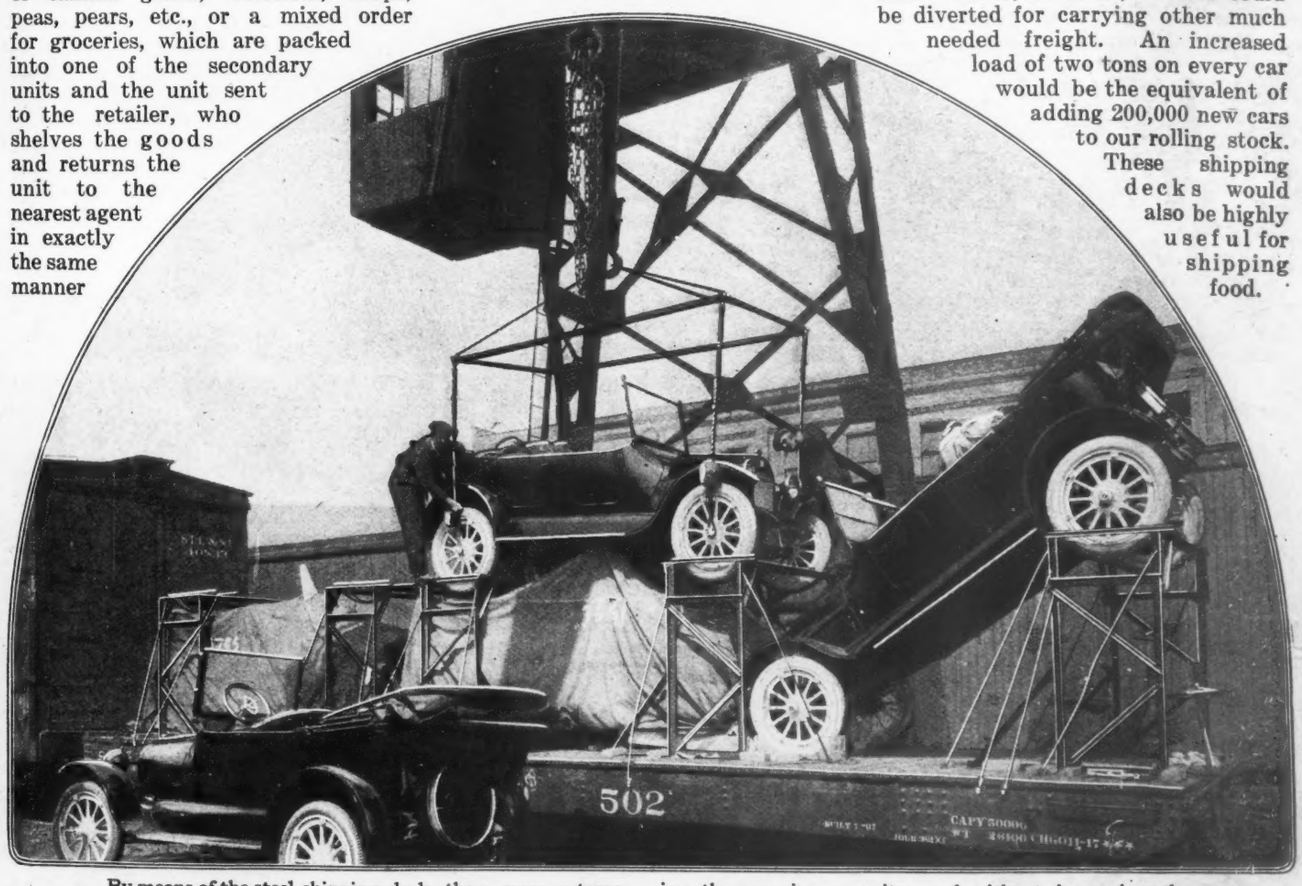
Not more than three automobiles can be shipped in a freight-car. By means of this trestle twice as many can be carried

The device consists of a trestle constructed of structural steel framework which can be quickly assembled or taken apart. The trestle is adjustable, and may be placed and fastened down on or in any freight-car wherever it is required. The loading deck may be used on flat-cars or in box-cars, and makes it possible to increase the capacity of a car from sixty to one hundred per cent.

A Saving in Freight Charges

To illustrate the saving of space made possible by this device, let us consider the case of the average flat-car, which will hold three large automobiles, standing end to end on its platform. With the steel shipping deck three more automobiles of the same size may be placed above the three machines resting on the platform of the car, without exceeding the carrying capacity of the freight-car and without increasing the height of the load beyond the normal height of a box-car. This means a doubling of the loading capacity of the car and a large saving in freight charges for the shipper.

The automobile industry in normal times uses about 90,000 freight-cars every month. Doubling the load of these cars would release one half the number of cars every month for other purposes. It may not always be possible or feasible to use the double-deck method, but it is safe to assume that from 25,000 to 30,000 cars could be diverted for carrying other much needed freight. An increased load of two tons on every car would be the equivalent of adding 200,000 new cars to our rolling stock. These shipping decks would also be highly useful for shipping food.



By means of the steel shipping deck, three more automobiles of the same size may be placed above the three machines resting on the platform of the car without exceeding the carrying capacity, and without increasing the height of the load beyond that of a box-car. The same principle holds good for crated eggs, vegetables, and fruit

Salvage Miracles Foil the Hun

Emergencies that confront modern ships as a result of submarine warfare, and how they are being met by resourceful ship captains

WHEN the rending crash of a German mine under the bows of his ship announced to the captain of the *Tipperary* (war alias of a famous Atlantic liner) that his ship "had got hers," he looked out across the ice-clogged lanes ahead and smiled grimly. Even if the *Tipperary* floated, it was three hundred miles to the nearest port, and the ice-floes were already tearing at the wounded hull. They were well into the Arctic Ocean on their way to Archangel, and winter was at hand. As the first officer said later, they "kissed themselves good-by."

The *Tipperary* did float. She was well built, and, while the mine had smashed a big hole abreast the No. 2 hatch, the aft bulkhead held. But the ship settled by the head and took a bad list—and every minute the ice menaced the broken bow. There was only one chance in a thousand to save the vessel and the five hundred men on board, and the "old man"—merchant marine slang for captain—took it.

The Captain Took the Chance

If the bow couldn't face the ice, the stern could; and if the rudder and propellers escaped mortal damage, the *Tipperary* might fetch the nearest land. So the captain sent her astern, and backed gingerly through a hundred miles of sea infested with ice and mines, until he beached his ship on as forsaken a bit of coast as the Arctic affords.

The captain reached land and an idea at one and the same time. Five minutes after the *Tipperary* struck, the crew had the hatches off and were hustling out the cargo. That cargo consisted mainly of boxes of empty shell-cases, and with these the crew built a breakwater to protect the stranded ship against the surf and the ice-floes.

A Winter in the Arctic

As the cargo went out the ship floated in her improvised harbor, clear of bottom except for the damaged bow, which dragged down. They blew the remains of the bow off with dynamite, shored up the forward bulkhead, and got ready to spend the winter where they lay.

Now, to winter five hundred men in the Arctic is a job for a diplomat of sorts. The "old man" tackled the double problem of keeping his crew safe from the insanity that breeds in the Arctic night, and of planning a rescue when spring came.

His ace in the hole was the wireless. With it he could talk with London, a thousand miles away. Presently the home office was saying nice things about the stunt the *Tipperary's* "old man" had pulled, and listening in return to instructions for a new bow, to be built according to specifications and delivered in the spring.

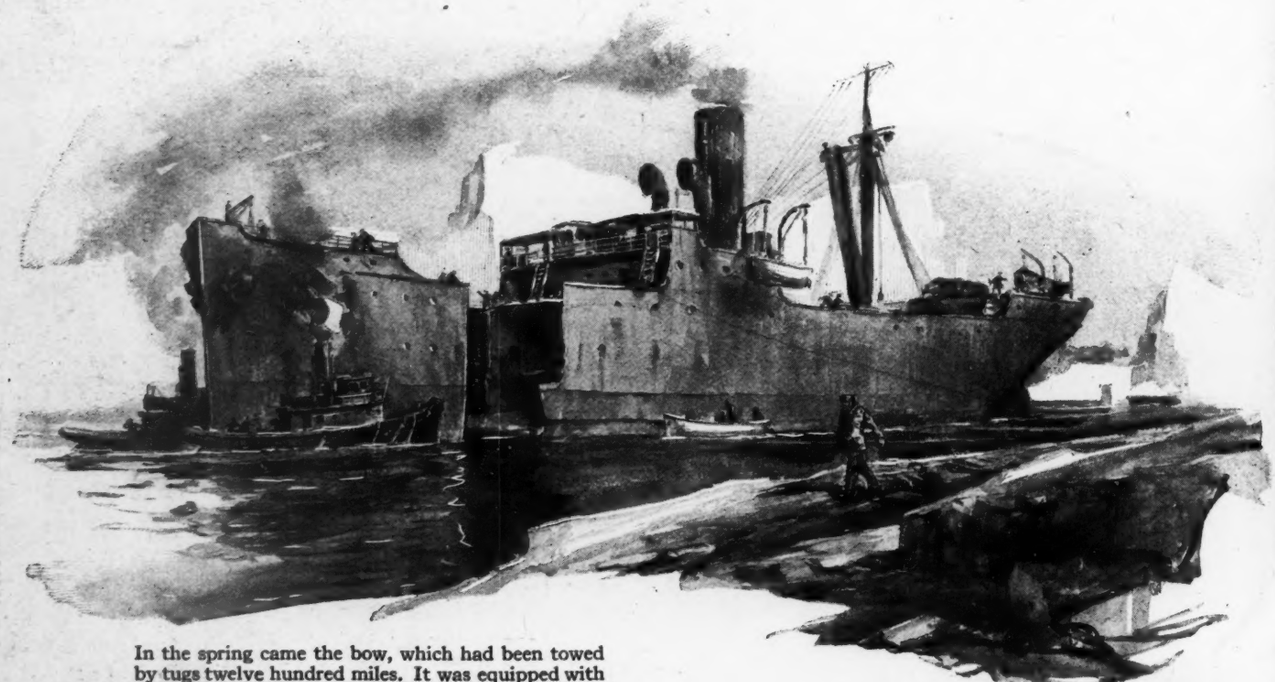
The captain put in the long days discussing the delicate building job via wireless, and inventing ways to keep his men busy. He drilled the crew on the ice, directed them in building and racing ice-boats, and even established a school, where the amateur teachers found it amusing to put up to the home office by wireless knotty problems that stumped them.

With spring came the bow, towed twelve hundred miles by tugs whose captains were as resourceful as the "old man" of the *Tipperary*. The bow was equipped with a socket fitting into the hull and forming a blow-out patch of the joint. They used electric welding to bring the two parts together, and the *Tipperary* sailed proudly home under her own steam.

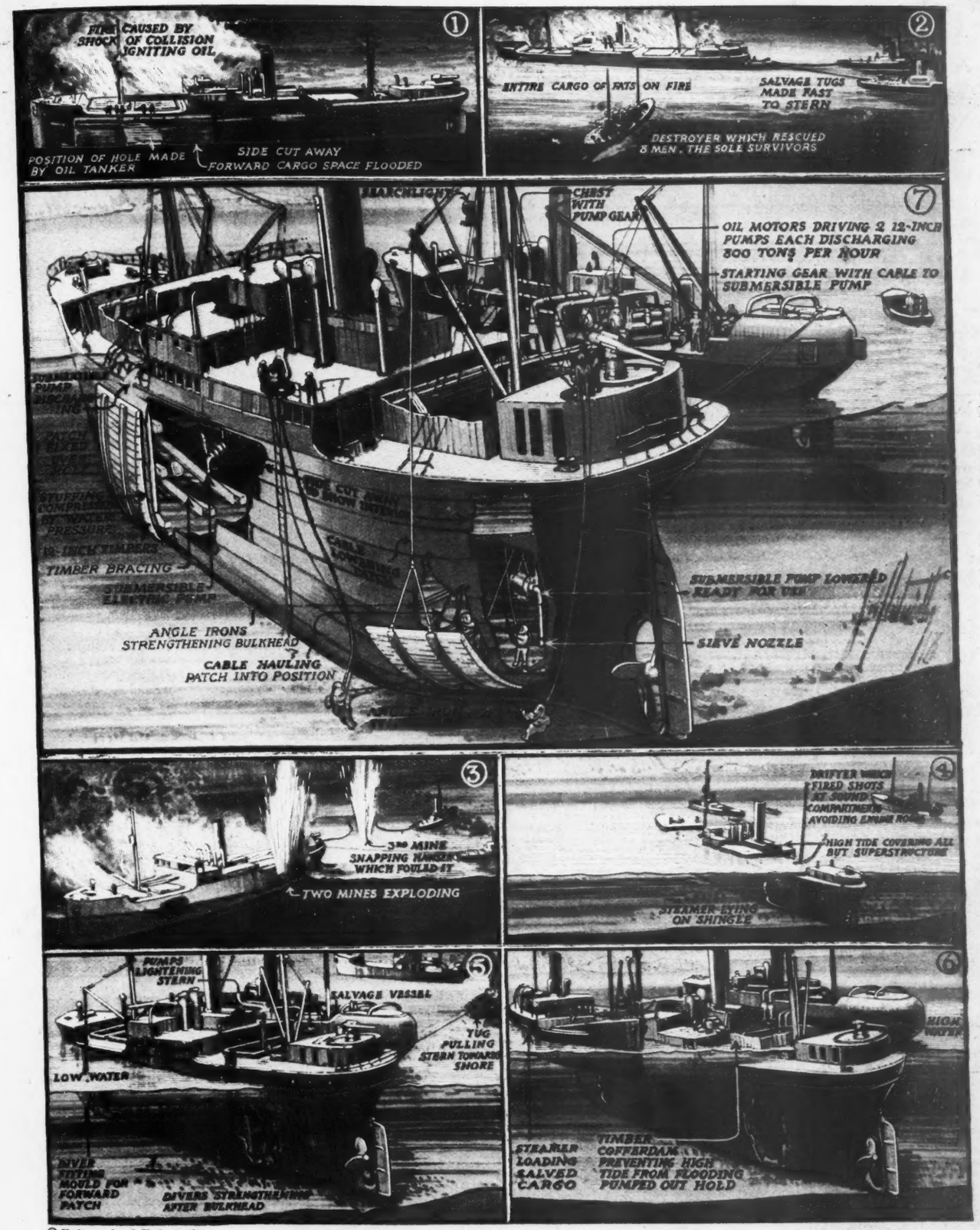
The "Euryanthe's" Experience

Another story, in some respects even more remarkable, is that of a standard British ship which we may call the *Euryanthe*, which collided with an oil-tanker. Salvage tugs started for shore with the *Euryanthe*, which was on fire, but near the beach the ship ran into a mine-field. Two mines exploded against her hull; another cut the tow-line. She had to be sunk to save her, and then the salvage operations began in earnest.

The story of the *Euryanthe's* remarkable experience is told in the pictures on the opposite page.



In the spring came the bow, which had been towed by tugs twelve hundred miles. It was equipped with a socket fitting into the hull and welded by electricity


1
FIRE CAUSED BY SHOCK OF COLLISION IGNITING OIL
POSITION OF HOLE MADE BY OIL TANKER
SIDE CUT AWAY FORWARD CARGO SPACE FLOODED
2
ENTIRE CARGO OF FATS ON FIRE
SALVAGE TUGS MADE FAST TO STERN
DESTROYER WHICH RESCUED 8 MEN. THE SOLE SURVIVORS
7
OIL MOTORS DRIVING 2 12-INCH PUMPS EACH DISCHARGING 300 TONS PER HOUR
STARTING GEAR WITH CABLE TO SUBMERSIBLE PUMP
SUBMERSIBLE PUMP LOWERED READY FOR USE
SIEVE NOZZLE
TIMBER BRACING
ANGLE IRONS STRENGTHENING BULKHEAD
CABLE HAULING PATCH INTO POSITION
3
3RD MINE SNAPPING HAWSERS WHICH FOULED IT
TWO MINES EXPLODING
4
HIGH TIDE COVERING ALL BUT SUPERSTRUCTURE
STEAMER LYING ON SHINGLE
5
PUMPS LIGHTENING STERN
SALVAGE VESSEL
TUG PULLING STERN TOWARDS SHORE
LOW WATER
DIVERS FITTING MOULD FOR FORWARD PATCH
DIVERS STRENGTHENING AFTER BULKHEAD
6
STEAMER LOADING SALVED CARGO
TIMBER COFFERDAM PREVENTING HIGH TIDE FROM FLOODING PUMPED OUT HOLD

© Underwood and Underwood

You Can't Keep a Good Ship Down

The thrilling experiences of the British standard ship *Euryanthe* are depicted above. No. 1 shows the ship after the collision. The cargo of fats is blazing and the forward cargo space flooded. In No. 2 the *Euryanthe*, still afire, is in tow of two salvage tugs. A destroyer has saved the eight survivors. No. 3 shows the blazing ship among drifting mines. Two mines tear a big hole in the port side; a third snaps one of the towing hawsers. No. 4 shows the *Euryanthe*, sunk by shots into the water-tight compartments, resting on the shingle. The fire is extinguished. In No. 5 the salvaging operations have begun. In No. 6 a steamer is loading the salved cargo. The large picture, No. 7, gives details of the salvaging operations. The after bulkhead has been strengthened, and divers are adjusting the patch over the big gap. Twelve-inch timbers have been placed across the hole on the inside to form braces for the standard patch, which is also made of stout timbers. Where the patch rests against the sides of the ship the joint has been made water-tight by elastic packing. After the water has been pumped out, the ship, once more afloat, will be ready to be towed to the nearest dry-dock for more permanent repairs and a general overhauling

Taking the Bray Out of the Army Mule

In the present war even the bray of the mule comes in for serious consideration

NO matter how faithful are the services of the army mule, there is one serious objection against him—his bray. Veterinary surgeons have been devoting a great deal of attention to the problem of how to deprive the mule of his ability to greet all and sundry with his loud and hearty *hee-haw, hee-haw.*

In time of peace it does not make much difference how much the mule may indulge in this form of pleasantry, but in war-time his loud bray may have serious consequences. Take, for example, a group of United States soldiers with their mules in hiding, ready to spring upon Fritz at the right moment. Suddenly a mule decides to bray. Carefully thought out plans go for naught, because Fritz now knows exactly where the Americans are. The mule has told him.

The Mule Must Raise Its Tail When It Brays

Two very simple methods have been devised for taking the bray out of the mule. Naturally, it has not been economical to perform on an animal an operation that would necessitate a long period of convalescence. Therefore, the most desirable operations are those from which the mule will recover immediately.

The first one of these is an operation that is performed on its tail. No, this is not a mistake. The mule's tail really has a lot to do with its braying. It is said that if a mule cannot raise its tail it cannot bray. When a mule gets ready to bray, it first throws its tail up, and then indulges in its favorite pastime.

Getting the Mule Ready for an Operation

Two small muscles at the top of the mule's tail control the raising of that appendage. If these muscles are severed, the mule cannot raise its tail. This operation is very simple and takes only a moment. It requires a great deal more time to get the mule ready than it does to perform the actual operation.

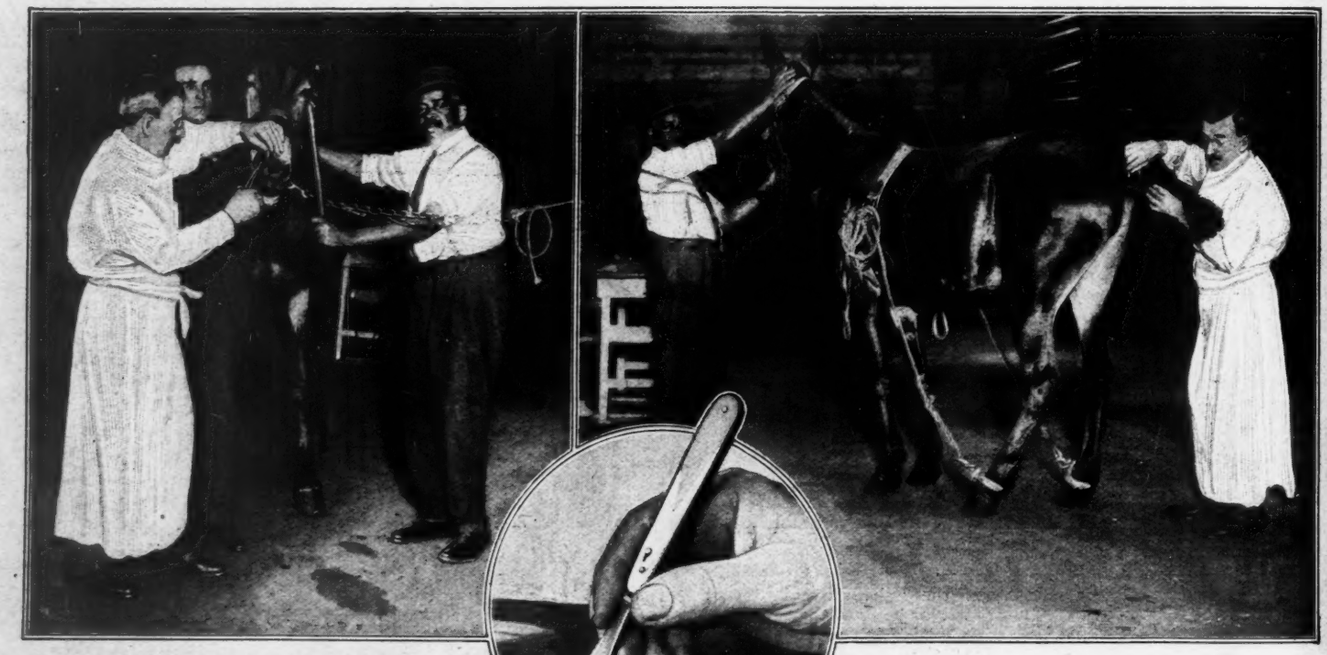
First of all, the mule is tied by ropes on each side of its halter. Then comes the fixing of the side-lines in place. These are used to prevent the mule from kicking; and, as the surgeon has to stand at the animal's heels, you can see how necessary it is to have the side-lines properly adjusted. The apparatus consists of a band somewhat like a collar, which is fastened around the front of the animal's body, and two side-lines, which are attached to the hind legs, just above the hoofs. The mule may struggle, but it cannot kick the surgeon or harm itself.

A special knife is used to take out the bray by this means. It is no larger than an ordinary office pencil-sharpener, and the incision it makes is so small that it is difficult to find the scar when the wound has healed. It does not incapacitate the mule at all.

Another Operation Acts as a "Dimmer"

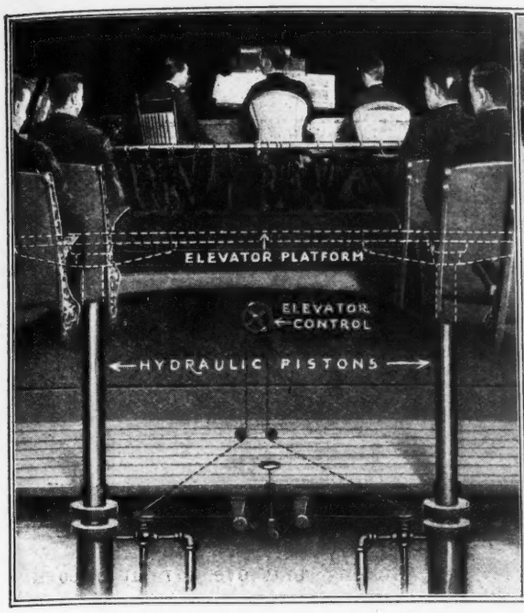
Another operation which acts as an efficacious dimmer on the mule's bray is the splitting of the false nostril. The mule's nose differs from that of the horse in that it has what is termed a false nostril. That is to say, it has a nostril through which it breathes, just like a horse; and, alongside of that nostril, a pocket which extends for several inches above the real nostril.

When the mule brays, the sound is greatly magnified by this false nostril. Therefore, it has been found that the simple operation of splitting the false nostril, thereby making it a part of the real nostril, greatly subdues the sound of the mule's bray.

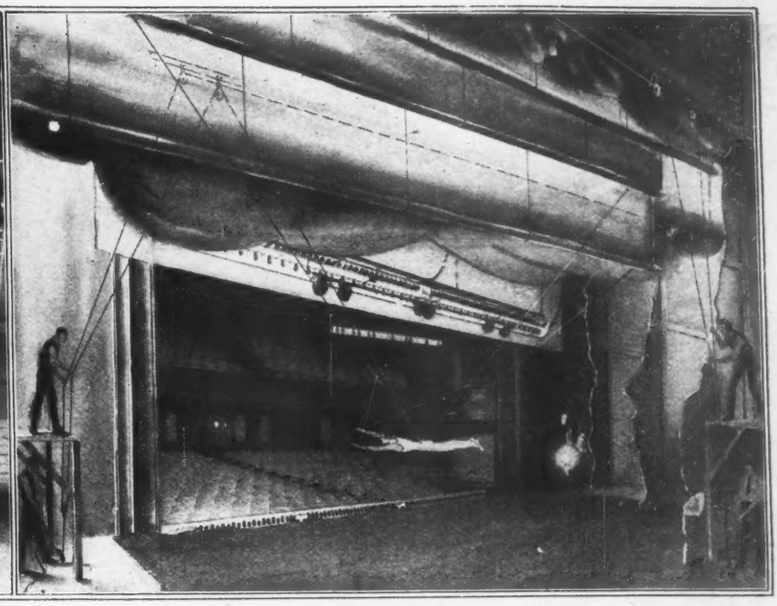


Dr. Henry Henning, of the New York State Veterinary College, splitting the false nostril of a mule in order to subdue its bray. This is one of the commonest methods of removing the mule's bray

Here Dr. Henning is performing a slight operation to prevent the mule from raising its tail. If a mule cannot raise its tail, it will not bray. The knife on the left is the instrument used in this operation



In a few minutes the audience will probably be shocked at the sudden disappearance of the orchestra



The operating and tackle cables give the actor any desired motion through the air. He can also produce certain desired turns by pulling invisible wires

"In Again, Out Again": Orchestra and Pit Lowered Complete

TALLY'S Theater, one of the finest moving-picture theaters in Los Angeles, is equipped with a mechanical orchestra-pit which brings on the orchestra and takes it out again without all the fuss and commotion that usually attends the ducking in and out of musicians through the little door under the stage.

The mechanical orchestra-pit is nothing more than a large flat-topped plunger-type elevator. The platform is lowered to the basement, and there the musicians, with their complete equipment, get on board. When it is time for the music, a button is pressed and the orchestra rises silently into the view of the audience. Likewise, during parts of the performance in which no music is needed, the orchestra drops out of sight so quietly that the audience seldom notices that it is gone.

What would happen to any musician who did not arrive in time for the rising is puzzling. There is apparently no trap-door in the pit through which he might crawl, so most likely he would have to wait patiently below for the platform to make its next trip.

"The mechanical pit cost fifteen hundred dollars," says Mr. Tally, the owner of the theater. "Its cost of operation is trivial when compared with its value as an asset to the play-house."

The effect on the audience is decidedly pleasing.

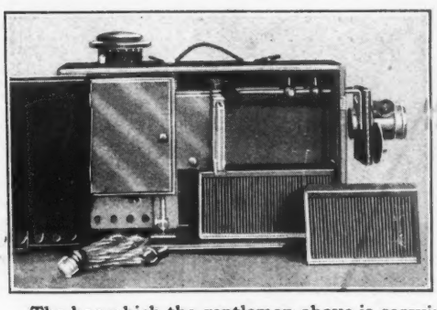
A Portable Outfit for the Lecturer

THE lecturer who carries with him his slides, lens, lamp, and other essential parts of a projecting apparatus need no longer journey heavily laden. The outfit shown in the photographs combines efficiency in operation with ease of carrying because of lightness and compactness.

Despite its small size, the "grip" contains the lantern, the projecting apparatus, the lens, space for seventy-five standard slides, and several feet of wire with a plug.

The apparatus has every necessary device for shifting the light to the best position, for ventilation at top, bottom, and sides, and for throwing the illustrations upon the screen just as needed.

The whole outfit, exclusive of the lantern slides, weighs only twelve pounds, and measures six by eleven by seventeen inches.



The bag which the gentleman above is carrying contains paraphernalia for an illustrated lecture. The lower picture shows it opened

Flying on the Stage—and How It Is Done

VAUDEVILLE performers who float about the stage playing in mid-air on equally "buoyant" pianos, or who swim up, down, and around in the rather unsubstantially thin air, never fail to appeal to the coldest audience. Mysterious as such feats always are to the uninitiated, they are commonplace matters of business to the men behind the scenes. As any of these men will tell you, the secret of such performances is that extremely thin steel wires are used, which, especially on a darkened stage, are practically invisible even at a short distance.

A more complete "inside" view of the mechanisms that are employed is given by the patent on a simplified system which has been issued to Erich Rach, of New York city. The performer is strapped on a concealed saddle provided with a special suspension joint.

Attached to this joint, and holding the saddle, are four thin wires. These are carried over six sheaves at the corners of the top of the stage. These four wires are connected up so that they make two distinct and closed wire circuits, as shown in the illustration above.

By pulling on the proper operating cables of both circuits, the performer is carried longitudinally across the stage. If one tackle cable is pulled and the other is let out, however, the performer is moved transversely over the stage.

Pictures courtesy *Pan-American Record*

A live seepage, or little river of oil, with tiny bubbles beginning to form on its surface

There's the promise of a fortune in the rainbow colors of this giant bubble blown by gas

The bursting bubble leaves a miniature crater

Giant Bubbles that Foretell a Fortune

IT may seem a far cry from hunting oil in the Mexican jungle to hunting submarines in the English Channel, but they are closely related occupations. The greater number of the destroyers, chief of the submarine-hunters, are oil-burners, and most of the oil that they burn comes from the Mexican wells. So the hunters are akin.

The hunt for oil is not without its romance. Some of the richest of the Mexican oil reservoirs are in limestone, and the oil makes its way through fractures and faults in the rock, forming pools (or "seepages," as they are called) and asphalt deposits. These seepages and deposits are the best of evidence that oil exists in worth-while quantities, and that well-drilling is reasonably certain to have its reward, and not dependent upon chance, as was the case with the locators of one well, who chose to drill at the spot where a crow alighted. They struck oil, too!

The oil-hunter often has to make his way through dense jungle, where the silence is unbroken except for the falling of a dead branch or the bursting of oil bubbles.

The latter is a pleasant sound in the ears of the oil-hunter. Looking about, he discovers a seepage, perhaps a flow large enough to be called a river of oil.

In the center of an active seepage the bubbles—caused by natural gas trying to make its way through a film of oil—will form quickly. As the bubbles grow, the heavier, darker oil falls away, leaving a large, clear bubble with all the hues of soap-bubbles. If the deposit is semi-fluid, the developing of the bubbles is slower, and when they break it seems to be with a sigh of relief.

How a Caterpillar Loads Itself on a Truck

THERE is tremendous activity in the rear of the Allied lines. The army in the sector is advancing, and that means work, work, and still more work. Guns, big and small, have to be brought forward, and with them the necessary ammunition and the reserve stores that must be held in readiness at all times. Rolls of barbed wire, telephone and telegraph wires, spare wheels and other parts of artillery equipment, and a thousand other things must be constantly within reach.

Powerful caterpillar tractors carry whatever is required close up to the fighting line. They can climb over nearly any obstacle, but eight miles an hour is their limit under the most favorable conditions. When time is pressing and every minute counts, more rapid means of transportation is necessary. The caterpillar tractors are urgently needed at the front, but it would take too long to run them under their own power.

To carry the unwieldy trucks to the place where they are needed, special trucks are used. Skids are placed on the rear end of the truck, so as to form an incline, on which the caterpillar tractor, under its own power, climbs upon the truck. On smooth roads this truck travels several times as fast as a caterpillar. Where the rough ground begins, the caterpillar, loaded with the necessary supplies, backs down the incline and continues to the front by its own power.

The picture below shows one of these tractors loading itself on a truck. The skids as well as the platform of the truck are provided with spaced slats just wide enough to fit between the raised ridges of the caterpillar tread-belts.

© Press Illustrating Service

This caterpillar climbs on the truck which is to convey it speedily within reach of the front, when it descends and proceeds under its own power

Domesticating the Airplane in Crowded Cities

How the problem of providing starting and landing facilities might be solved

By Carl Dienstbach

Just as the commercialization of the automobile depended on good roads, so that of the airplane depends on adequate landing platforms. One suggestion (not to be taken too seriously) is that of a series of ropes, fastened to sandbags, and stretched across a platform. The ropes bring the airplane to a stop

THE airplane has come to stay. It has passed through its probation period in a remarkably short time, and, since the beginning of the Great War, has developed with a rapidity unparalleled in history.

"But," ask the doubters, "will it ever become commercialized, as is the automobile?"

It is quite safe to answer "yes." It is true, the obstacles to the successful commercialization of the airplane are, in some respects, greater than those that had to be overcome in the case of the automobile; but they are by no means insurmountable.

Lack of Landing Facilities

The greatest obstacle to the commercialization of the automobile in the early days of motoring was the lack of good roads. That obstacle was removed in a remarkably short time. The most serious obstacle to the commercialization of the airplane is the lack of adequate starting and landing facilities where they are most needed —that is, in large cities, where wealth and business are centralized.

Now that the aerial mail service between New York, Philadelphia, and Washington has become a permanent and rapidly growing institution, the plan has been proposed to eliminate the delay of transmitting the mail from the post office to the remote starting field or from the landing field to the post office. Why not erect on the roof of the Post Office Building a permanent platform for the starting and landing of the mail-carrying airplanes?

The plan is by no means impractical, in spite of the objections offered by its opponents. A catapult, similar to that which now speeds seaplanes from shipboard, would insure the mail-plane a safe start from the roof. A safe landing could be made possible by a device similar to one tried with success some time ago.

On the deck of a cruiser, a series of ropes fastened to sand-bags were stretched across the landing platform. The weighted ropes gently retarded the airplane and it came to a full stop without injury. A railing in front of the propeller would make the device equally applicable to the tractor biplane.

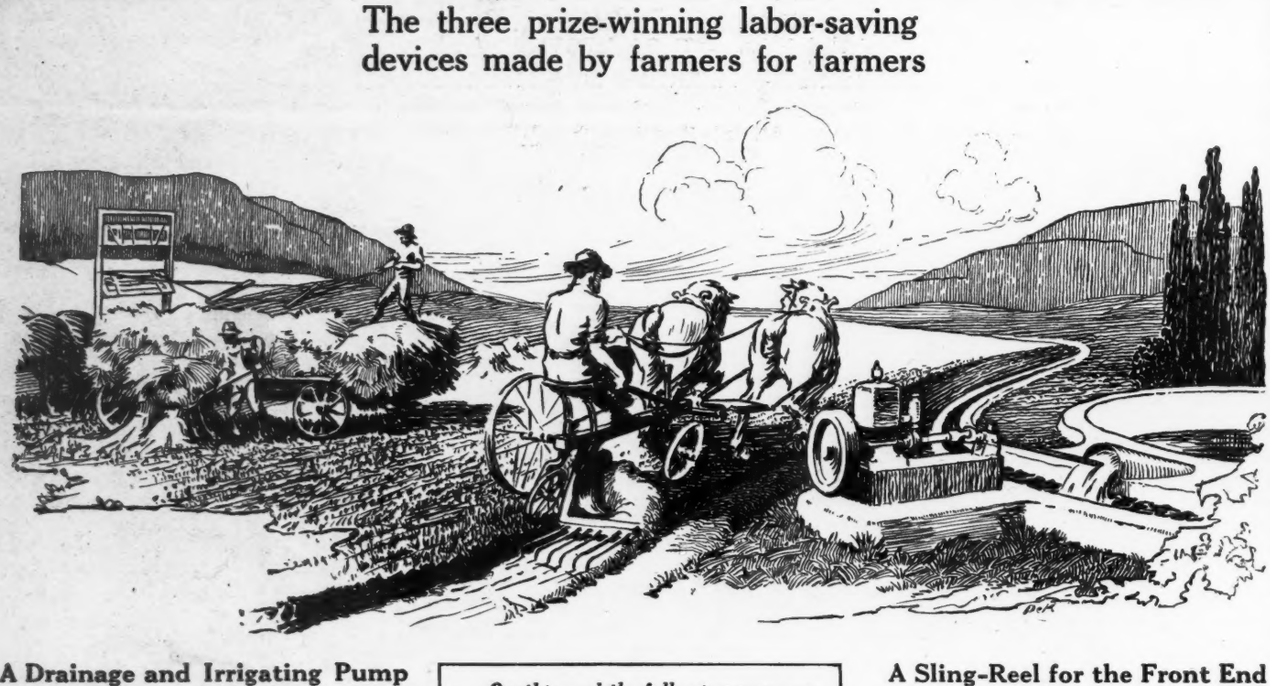
A Revolvable Platform

The device might even be improved and simplified by employing a single "catch-cable" wound around drums supplied with suitable brakes. The landing platform would have to be revolvable, because airplanes must always land against the wind.

The erection of such a platform would tend to promote the commercialization of the airplane. Soon airplane garages would be built, with huge elevators for the machines.

Who Won Our "Helping Out the Farmer" Contest

The three prize-winning labor-saving devices made by farmers for farmers



A Drainage and Irrigating Pump Made from a Motor-Boat Engine

First Prize Article

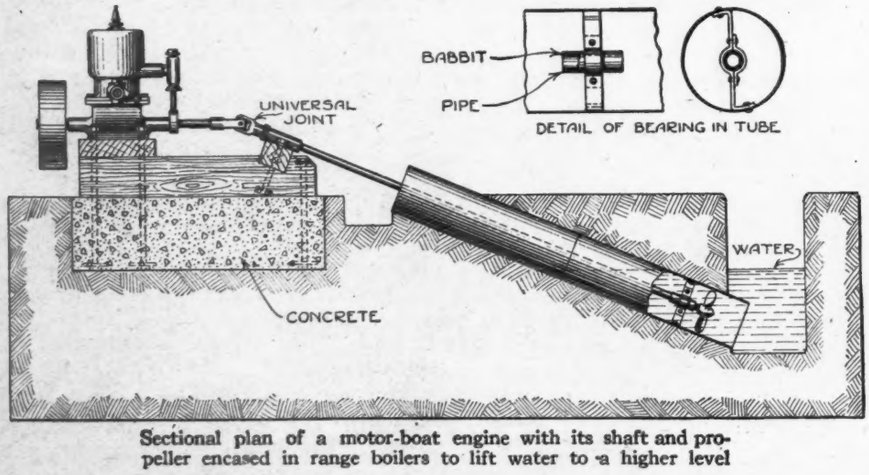
HAVING occasion to drain a low place in my land, a motor-boat engine was made use of for the power plant, and its propeller for the pump. The propeller lifted the water to a higher level, from which a fall carried it away.

In this instance discarded hot-water boilers were used for the tube. The ends were removed from the boilers and then joined together in a tube. Within the tube thus formed were placed two bearings for the shaft. These bearings were made from a piece of 1½-in. pipe 5 in. long, filled with babbitt, as shown in the detail sketch, and were supported by pieces of metal, as shown.

A three- or four-horsepower engine is large enough for all purposes. A three-blade propeller having a 12 by 17 in. pitch may be used with a three-horsepower engine and a 14 by 17½ in. pitch with a four-horsepower engine—engines supposed to run at the rate of six hundred revolutions a minute.

Large tile may take the place of range boilers. In this case the supports for the bearing will need to be made in a ring to fit the inside diameter of the tile.—SEBASTIAN VIERENGEL.

On this and the following page are the three articles that won the prizes in the "Helping Out the Farmer" contest. Many other articles were received and purchased at regular rates, and they will appear soon. Such exchange of ideas helps the other fellow and tends toward efficiency. Another contest is about to start. {You will find details of this new prize offer on page 112.—The Editor.

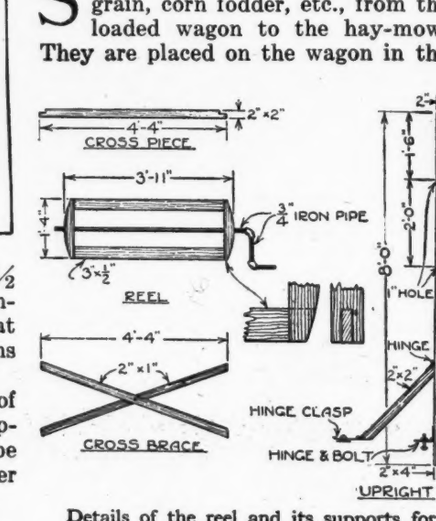


Sectional plan of a motor-boat engine with its shaft and propeller encased in range boilers to lift water to a higher level

A Sling-Reel for the Front End of a Hay-Rack

Second Prize Article

SLINGS are used for elevating hay, grain, corn fodder, etc., from the loaded wagon to the hay-mow. They are placed on the wagon in the field, and the successive layers of hay or grain placed on them.



Details of the reel and its supports for the front of an ordinary hay-rack

To use the slings successfully you must always carefully place them before loading. If the sling is upside-down, it will not trip when unloading. If the wrong end is in front, the proper pulley will not be hooked in; then much trouble follows in getting the sling back to the wagon. When the slings are carried to the field in the usual way, hanging on the front standards of the rack, they become tangled and twisted, requiring much labor and patience to straighten them out.

The sling-reel shown reduces the labor and time required in placing

the sling to a minimum. It consists of two wood standards securely braced at the bottom and connected with a cross-piece at the top. Between the standards, and supported by them, are two or three (as the case may require) reels, each having a crank attached to the end. The standards are attached to the front end of the hay-rack by means of two strong 6-in. T-hinges, and are held upright by two braces fastened to the back of the standards with 2-in. strap-hinges, and to the top of the rack by hinged clasps held down with tapering wood pins. By removing the wood pins and lifting the braces, the entire reel can be folded down on the rack out of the way.

When the sling is pulled down in the barn, the end that is used on the front of the rack is unhooked from the pulley. The ring in the end is given several turns to twist the two ropes attached. The ring is then thrown around the pipe in the center of the reel and forced between the twisted portion of the ropes. This will hold the end of the sling securely. The sling is then wound on the reel by means of the crank, the free end of the sling being tied with the trip-rope.

The sling-reel, with the first sling laid out on the bed of the rack

The sling-rack in use on a hay-rack where the second sling is being drawn out on top of the first layer ready for loading the second layer on the rack

The lower sling is usually not wound on the reel, but is placed on the rack, ready to be loaded on reaching the field. After the lower sling is loaded, the end of the next sling is untied and pulled to the back of the wagon and loaded, then the next sling, and so on until the wagon is loaded.

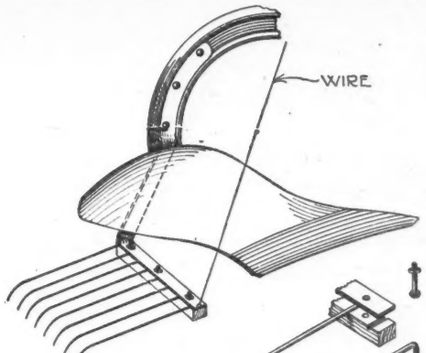
If four slings are used to the load, three reels should be placed in the frame. If three slings are used, the lower reel may be left out, as shown in the picture.—ALFRED J. KAHLER.

A Small Follow-Up Harrow for a Single Plow

Third Prize Article

THERE is nothing on our farm that saves more labor than a simple little one-furrow follow-up harrow that was made from a piece of wagon tire and some old hay-rake teeth. It is attached to the beam of the sulky plow by means of an ordinary coulter clevis.

To make the harrow, a piece of hickory 18 in. long and 2½ in. square was shaped to hold the teeth ends. Through this piece three ⅜ in. holes were bored, one being in the center and the other two each 3 in. from each end of the stick. Then in the upper side and on front of the block, grooves were cut to fit the ends of the old rake teeth. These grooves were cut 2 in. apart. The teeth, shaped from old hay-rake teeth, were made 15 in. long, with the end turned at right angles to fit over one corner of the block.



Harrow attachment for a plow-beam for dragging over freshly turned earth

Three holes were then drilled in an old wagon-tire to coincide with the three holes bored in the block, and the continuation of the tire was bent to clamp on the side of the plow-beam. The shape of this extension should be in such a form that the teeth of the harrow will hang directly over the newly turned earth as it comes from the moldboard. This arm is further braced by a wire attached to its outer end and fastened to the plow-beam. When the bolts are all screwed up tight and the clevis snugly fastened, the harrow does its work perfectly, just as fast as the fresh earth is turned.—A. A. JEFFREY.

Warm a Lens to Make Photograph in Cold, Damp Places

HAVING occasion to take some flashlights in a mine, I found that the moisture persisted in settling on and fogging the lens, and that wiping it off did not clear it, for, the moisture would immediately settle there and prevent the making of the picture.

The difficulty was overcome by taking the camera to the cook house and placing it in the oven for a few minutes. The oven door was kept open and I held the instrument with my hand so that no damage would occur by too much heat. When the lens was thoroughly warmed I wrapped the camera up and carried it under my coat to the place selected to make the picture. The moisture had no further tendency to settle on the lens and without any difficulty I obtained as perfect photographs as would have been secured under perfectly normal conditions.

There are many places where similar conditions face commercial as well as amateur photographers, and this method will relieve their trouble. Care should be taken always not to overheat any lens but particularly a high speed one.—JOHN EDWIN HOGG.

A Transparent Lacquer for Celluloid Surfaces

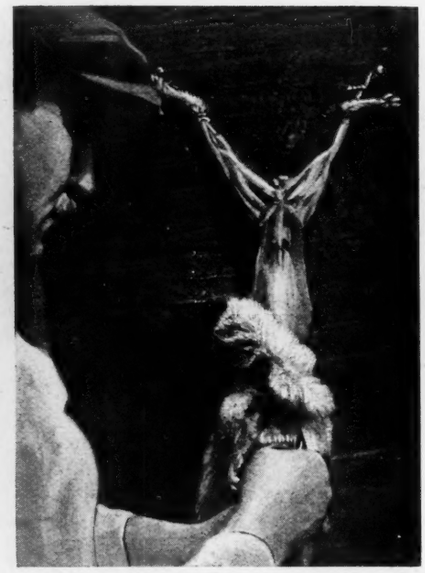
DISSOLVE uncolored celluloid in a mixture of strong alcohol and ether. The celluloid at first swells up in the solvent.

When this is done shake the bottle vigorously and permit it to stand quietly so the undissolved portion will settle. Then pour off the clear supernatant fluid. The latter may be used immediately. It yields a colorless glossy lacquer, and it may be colored with aniline colors.

How to Skin and Dry Pelts

Two methods of curing the winter skins of fur-bearing animals

THERE are two kinds of furs, the winter fur, which has long hairs, and the summer fur, which has short hairs. The color of the hairs also varies with the seasons. But, above all, the desirable wool of the animals' winter coats is entirely absent in summer. In winter only are the fur-bearing animals covered with their beautiful warm hairs, which are so valuable.



The rear legs are girdled near the feet, and a longitudinal cut is made on the inner side of each thigh. The skin is then carefully removed by pulling over the body. Wherever necessary the meat is cut from the skin

In order to skin fur-bearing animals, the hind legs are girdled just below the paws. The skin is then cut down the inner side of each leg at a place where the hairs begin to part. When both legs have been cut, the skin is carefully pulled downward so that no fat nor meat clings to it. Wherever it does cling, it is carefully cut away with a sharp knife.

The pelt is drawn over a wedge-shaped board which can be bought in all sizes

After the animal has been skinned, the fur must be dried. This process is of the utmost importance, as poor drying causes the fur to rot. The most practical method of drying skins is that in which the fur is stretched on a board. The board is 3 ft. long and 7½ in. wide. One end of the board tapers to a rounded point 3¾ in. in width. All sharp edges must be beveled. The pelt is pulled over the stretcher in such a way that the hairs are on the inner side of the board, while the skin is exposed to the air. Particles of meat are carefully cut away. The pelt is now stretched taut so that the head rests tightly against the rounded point of the board.

The Other Method

Another equally good method of drying skins is by stretching them on a large rectangular board, 3 ft. wide and 4 ft. long. The back of the board should be reinforced with two or three strips of wood to prevent warping. In order to stretch the skin on this board, an incision is made on the abdomen. From the incision a cut is carried both to the tail and to the tip of the chin. The pelt is now laid on the board with the skin exposed to the air. After the skin is stretched equally in all directions so that no ridges are formed, it is tacked to the board, the nails or brads being driven in along the edges. One must be careful not to employ force in stretching.

While drying, the furs must be kept in a shady but well ventilated place. The length of time necessary for this process varies with the seasons. It may take from five to fourteen days, seldom longer, and never less. The drying of the skins can not be accelerated by artificial means. Excessive heat (heat from stoves or fires) spoils the fur. The same applies to the heat of the sun. If hung in warm places, the particles of fat adhering to the skin melt, discolor the leather, and form glassy spots.

While the furs are drying they must be kept in a place where they are safe from rodents. The well known fur pest, the moth, must also be banished from the drying room. The surest way to keep them away is to produce a strong draught through the drying room.

If the incision is made in the abdomen, the pelt is stretched on a flat board

The stretched pelts are considered dry when they appear hard and bony to the touch. It is best to dry the skins thoroughly then they will keep indefinitely if properly packed.

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Inquire about special terms to professionals

Now Uncle Sam begins arming the country's factories to conquer the Hun!

THE minute the United States declared war, the factories of the country became an important element in the struggle. On their output of munitions, food, clothing, airplanes, ships, etc., depended in a great measure victory or defeat.

For a time every effort was centered on production, on speeding up, on increasing output. But in this one year Uncle Sam saw tens of millions of dollars snatched from his war-machine by fire. In one year he saw thousands of irreplaceable fabricating-machines and tools wiped out by fire. In one year he saw fire take from his fighting men shipload after shipload of vitally needed finished products.

One year was enough!

Uncle Sam learned in a twelvemonth what many business men have not learned in a lifetime. He learned that insurance money could never re-create the victory-winning, Hun-crushing supplies that have gone up in smoke.

He learned more. He learned that such destruction was as foolish as it was dangerous because there is an infallible answer to this challenge of fire. His War Industries Board found out that, more than 35 years ago, Frederick Grinnell had invented a weapon—the automatic sprinkler—by which fire would annihilate itself.

At the beginning of the second year, Uncle Sam acted. Today sees the entire resources of this industry devoted solely to the work of rushing sprinkler equipments into factories, warehouses, grain-elevators, etc., specified by the government. This requires the total output of our factories.

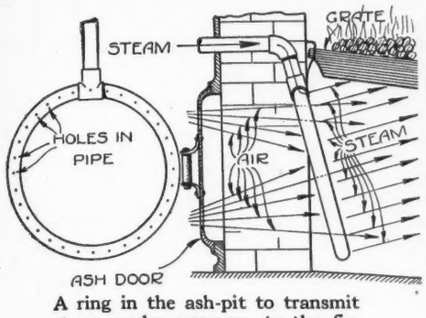
The General Fire Extinguisher Company
290 W. Exchange Street, Providence, R. I.

"We are as proud of the 1500 men putting in these systems throughout the country and of the 1500 employees in our seven great plants fabricating these systems as we are of the 500 men we have with the colors in France."

GRINNELL
AUTOMATIC SPRINKLER SYSTEM
The Factory-Assembled System

A New Steam-Air Blower for Forced Draft

THE accompanying illustration shows the simplest but most efficient furnace blast. It is available wherever there is steam pressure that has ever been devised. It consists of an air duct about 1 ft. in diameter



A ring in the ash-pit to transmit steam under pressure to the fire

leading to the fire-box and carrying at its mouth a somewhat flattened hollow brass ring perforated on one side with small holes. From this ring a pipe leads to the steam chest, and as the steam is turned on the pressure in the duct drives the air before it leaving greatly diminished pressure behind and creates a tremendous draft into the fire box. The steam which is carried in with the air is not sufficient in quantity to cool the fire.

Hitherto there have been only two common ways of producing a draft. One is to build a tall chimney and the other is to produce a forced draft with a motor and fan. The building of a tall chimney is often a disfigurement to what would otherwise be a beautiful piece of architecture, but the blower here described makes this unnecessary. It is also the most economical form of a forced draft possible to obtain.—FLOYD L. DARROW.

Try This Apparently Hard Trick on Your Strong Friends

DO you know that a person of ordinary strength, by putting the tips of the forefingers together a

You can't draw your fingers apart when standing in this position

little above the waist level, can with little effort resist their being pulled apart by another person? The person pulling should stand directly in front of the other; the arms should be gripped immediately above the elbows, and pulled (not jerked) horizontally.

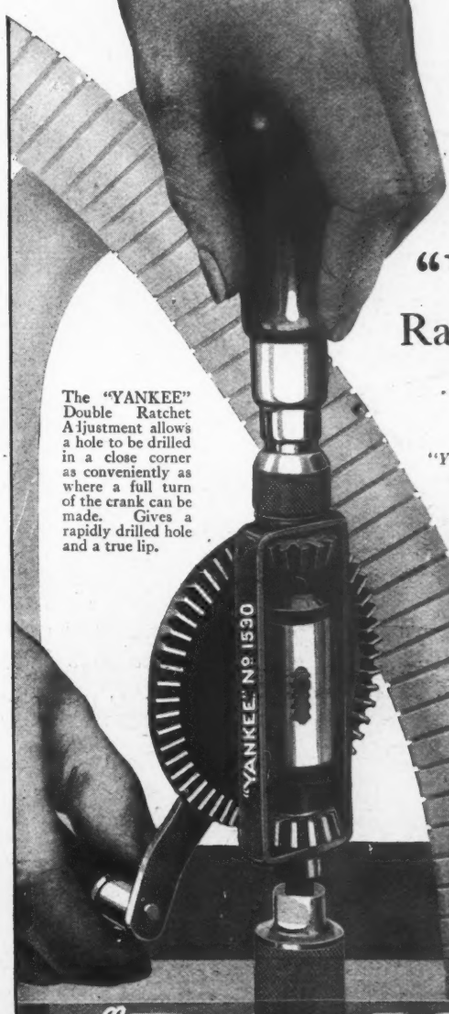
Multiplying Man's Power

How often you lose an hour getting a five-minute job out of some tight corner, where you can reach it with a common drill!

This "YANKEE" Ratchet Hand Drill, No. 1530, is one of the many "YANKEE" tools cleverly designed for dodging difficulties and speeding up the job. It has five adjustments, all controlled by your finger tip.

1. Plain Drill
2. Left Hand Ratchet
3. Right Hand Ratchet
4. Double Ratchet
5. Gears Locked

No similar tool has these adjustments. No matter how close the corner; if you can move the crank *at all* you can drill the hole.



The "YANKEE" Double Ratchet Adjustment allows a hole to be drilled in a close corner as conveniently as where a full turn of the crank can be made. Gives a rapidly drilled hole and a true lip.

"YANKEE" Ratchet Hand Drill

No. 1530

Price $3.90

Your Dealer Can Supply You.

"YANKEE" Tool Book showing Bench, Chain, Breast, Hand and other drills sent free on request. Write for it.

North Bros. Mfg. Co.

Philadelphia

These Handles Never Work Loose

That's what "YANKEE" means on these screw-drivers, and is one reason it pays you to insist on this brand.

Handle and blade are fastened together to stay—absolutely!

"YANKEE" No. 90—Standard style, 15 sizes, 1½ in. to 30 in. blades, **25c** to **$2.35** each.

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"YANKEE" TOOLS

Make Better Mechanics

DU PONT AMERICAN INDUSTRIES

Be Thrifty—Re-upholster!

In these war times it is most wasteful to discard good furniture frames because the upholstery on them has become torn or shabby. Re-upholstering is a practical economy in every home. It is especially satisfactory when done with

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Craftsman Quality

Craftsman Fabrikoid is an upholstery material that exactly duplicates the finest leather in color, grain and finish and in its luxurious "glovey" texture. It is waterproof, washable, sanitary and amply guaranteed.

Re-upholstering is easy. Check "Craftsman Fabrikoid" in the coupon and send for our booklet "Home Upholstering." It gives methods for applying Craftsman Fabrikoid to various types of furniture.

Mark X before subject that interests you and Mail This Coupon to
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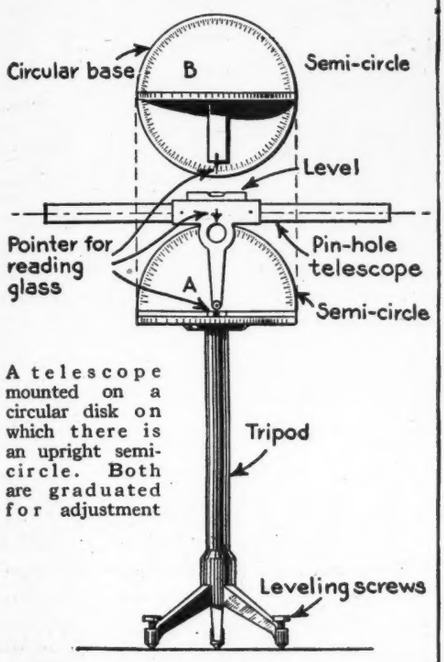
DU PONT

Construction of an Altazimuth for Locating Stars

AMATEURS interested in astronomy may readily trace the diurnal path of the brighter stars by means of the apparatus shown in the illustration. It is nothing more than a substitute for the more expensive instrument, but gives very satisfactory results if care is exercised in its construction. As the name implies, it is used to ascertain the altitude and azimuth of a heavenly body. The use of the instrument is not restricted to stars alone; it may be used for sights on the sun.

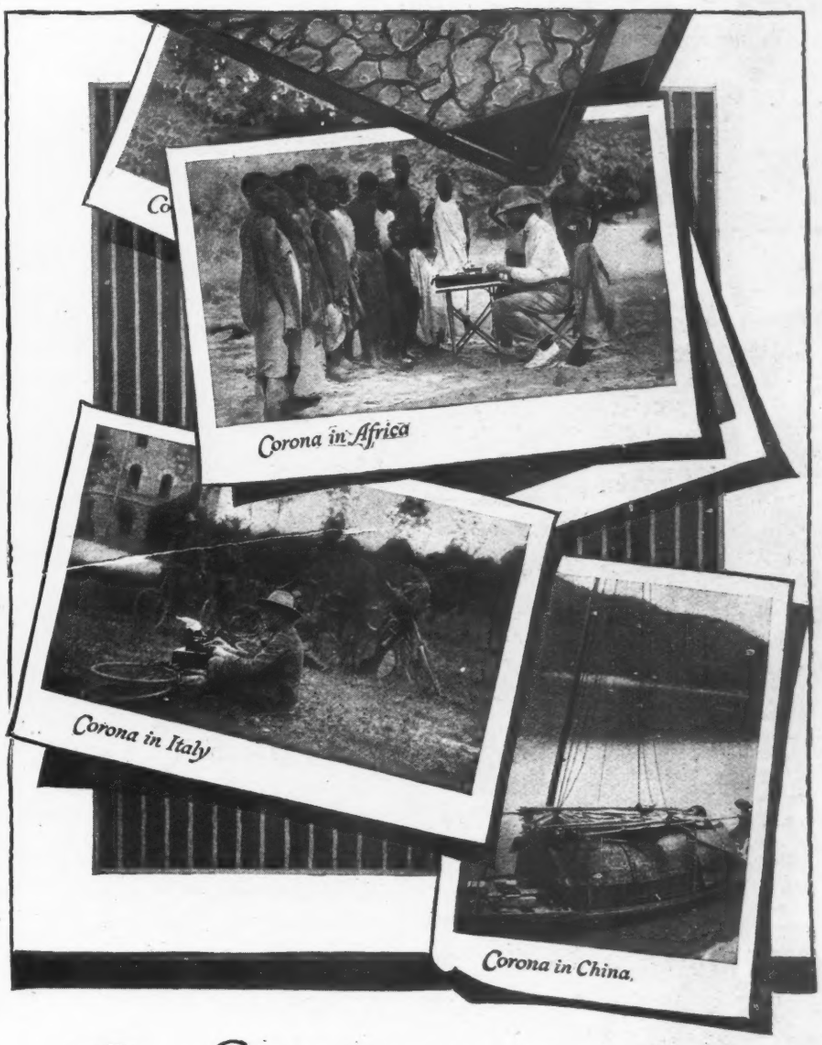
The pin-hole telescope shown in the illustration is movable about the point "*A*," the center of the semi-circle *B*. This semi-circle is mounted on a pin permitting it to revolve about an axis perpendicular to the horizontal circle, and its position on that circle is read off by the pointer which reads zero



A telescope mounted on a circular disk on which there is an upright semi-circle. Both are graduated for adjustment

when the plane is in the meridian. The horizontal circle is mounted upon a tripod provided with leveling screws. If the circle is so placed that the pointer reads zero when the telescope is in the magnetic meridian, then its reading when the sights are pointed at any star will give the magnetic bearing of the star. It is, however, more convenient to adjust the instrument so that the pointer reads zero when the telescope is in the true meridian.

To insure the verticality of the standard, a level is attached to the telescope, and by the use of the leveling screws, the instrument is adjusted so that the semi-circle may be revolved about its axis without causing the level bubble to move. A flashlight or other means of illumination will be necessary for reading the circles in full darkness; it should be shaded so that its direct light will not fall upon the observer's eye.



Complete with neat traveling case, Corona costs fifty dollars. Ask for descriptive booklet.

IT HAS fallen to the lot of the little Corona to meet tests which few other machines of any kind have ever encountered. Through every degree of hardship, in every climate, in almost every type of service, this six-pound writing machine has made good.

And while you may never venture behind battle lines or into African wildernesses, the knowledge that Corona has met these sterner tests is satisfying proof of its day-by-day dependability in your office or home.

A successful pioneer, a practical, portable writing machine, backed by a strong and experienced organization. A writing machine for your personal use—the more so because you can "fold it up—take it with you—typewrite anywhere."

CORONA TYPEWRITER CO., INC., Groton, N. Y.
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The Personal Writing Machine

GOODELL-PRATT

1500 GOOD TOOLS

No. 1917

Universal Caliper

Three Tools in One

THIS remarkable tool takes the place of an inside caliper, outside caliper, and a depth gauge. You do not have to change tools. You have the reading, both in English and metric, as soon as the measurement is made, and the spindle may be locked in any desired position by means of a thumb-screw.

With the Universal Caliper you can make any inside, outside, or depth measurement up to 4½ inches or 11½ centimeters. It is graduated on one side in 16ths of an inch, and on the other side in millimeters. The jaws can be easily adjusted to compensate for wear. Length over all, 7⅛ inches.

The Universal Caliper enables you to take measurements quickly, and is adaptable to any kind of gauging within its limits. Price, $2.50.

Makers of Mr. Punch

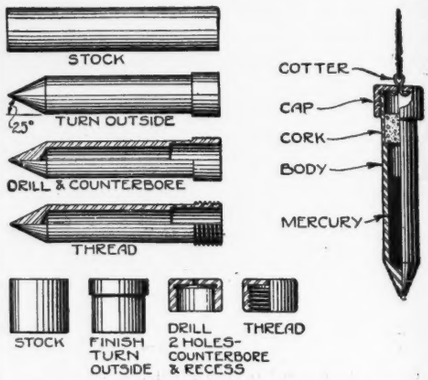
Goodell-Pratt Company

Toolsmiths

Greenfield, Mass, U. S. A.

How to Make a Mechanic's Mercury Plumb Bob

THE illustration shows the few operations required for making a simple but highly efficient mercury plumb bob. The body may be of ordinary cold rolled stock and the cap



Stages of development for making a receptacle to hold mercury for a plumb bob

may be of the same material. The cork can be easily removed by shaking the plumb bob vigorously, causing the mercury to act as an internal hammer. The amount of mercury used will be governed by the weight of the plumb bob desired. In finishing the outside, the body and cap may be left turned or polished as the fancy of the one making it dictates.

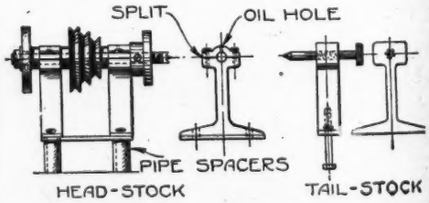
If the plumb is to be put to a great deal of use the point may be hardened.—FRANK W. HARTH.

Cleaning Aluminum to Bring Out Original Luster

ALUMINUM articles are very difficult to clean so that they will have a bright appearance. This is particularly the case with matted or frosted ware. To restore the pieces to brilliancy, you should place them for some time in water that has been slightly acidulated with sulphuric acid.

Making a Machine Bearing from a T-Rail

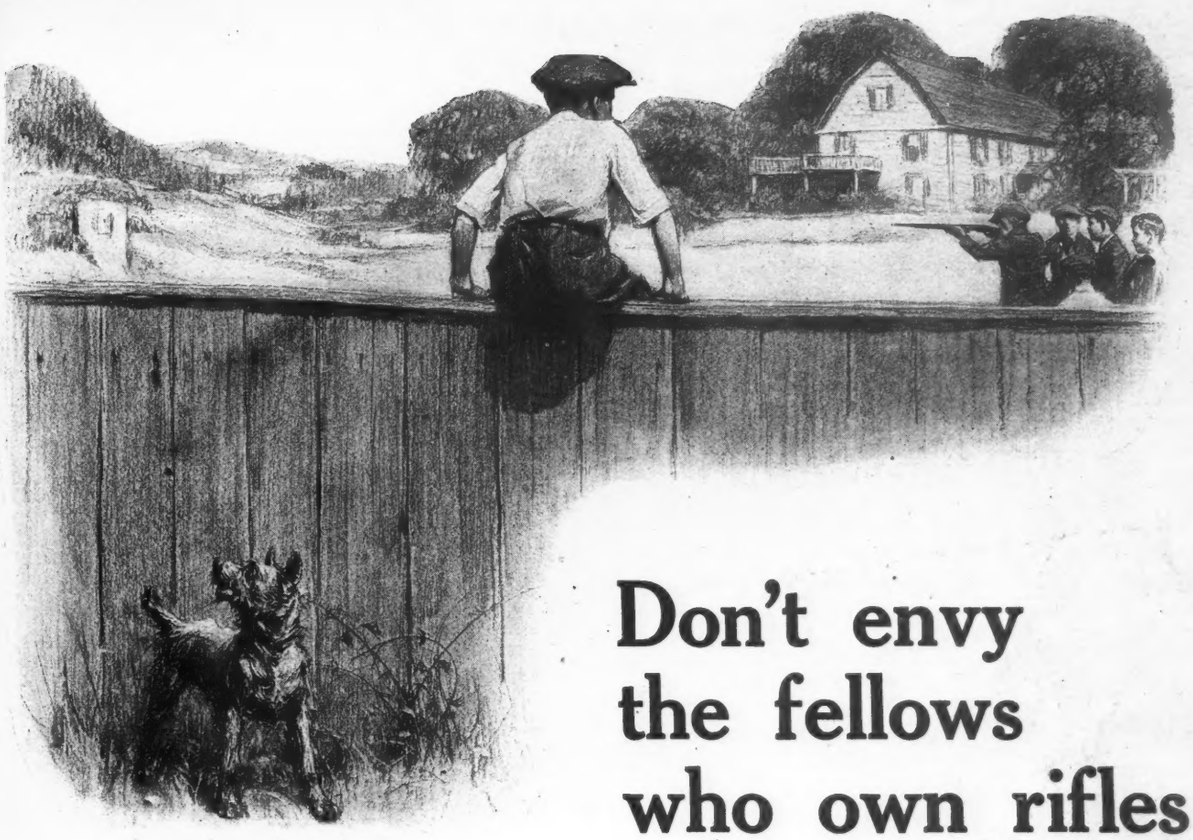
A BEARING standard for any countershaft and for various machine tools can be made from a piece of ordinary T-rail if it is not too diffi-



The shape of a T-rail is just right to make bearings for a machine

cult to cut it to size. The illustration shows one of its uses—for constructing a speed lathe and polishing head.

The details show how to shape a piece of this stock for making a bearing. A hole is drilled centrally in the base, if it is to be used for lathe purposes. For any ordinary standard the base edges are drilled. The head is drilled for the shaft.—L. L. FARRAR.



Don't envy the fellows who own rifles

WHO wants to sit on the fence and look on when the other fellows are shooting?

Every boy wants to own a rifle, and learn the joys of trigger magic. And every boy who has the right stuff in him *should* have one. When his parents understand how he can learn to handle a rifle safely, they will readily consent to his owning a gun of the right kind.

The right rifle to use

There is just one kind of rifle that a boy should start with, and that is the famous Winchester .22 *caliber rifle.*

With a .22 caliber rifle you can learn practically all there is to be learned from a rifle. Once you are proficient with a ".22" it is easy to become a crack shot with a rifle of any caliber. The .22 is the rifle used in all national small bore matches—and is used to train soldiers with.

Rules of gun safety

Now as to the handling of this excellent type of rifle. There is, as you probably know, a National Honorary Organization known as the Winchester Junior Rifle Corps, organized especially for the development of marksmanship among boys and girls of America and to teach the correct use of a Winchester .22 caliber rifle.

New members are given authoritative rules for the safe handling of the rifle from the very start, and are required on their honor to abide by these rules.

By joining the W. J. R. C., you will not only learn how to handle a rifle safely, but you will be entitled to a membership button and to compete for the famous Winchester Marksman and Sharpshooter medals awarded for skill with a Winchester.

Like the great Boy Scout movement, the Winchester Junior Rifle Corps is a nation-wide organization, open to every boy of good standing in his community. The age limit is 18. Its membership is growing daily.

Why not get your friends together and organize a Local Unit of the National W. J. R. C? There is hardly a town now that has not got its local W. J. R. C. Headquarters. There is probably one in your town where you can register as a member and get the Winchester button which your membership entitles you to wear. Your hardwear or sporting goods dealer is probably a representative. If you cannot get full particulars from him, write direct to **Winchester Junior Rifle Corps, National Headquarters, 275 Winchester Avenue, New Haven, Conn., U.S.A., Division 872.**

MODEL .06. Take-down Repeating .22 Caliber rifle, 20-inch round barrel. Shoots three sizes of ammunition. The most popular .22 Caliber repeater ever placed on the market

Winchester Sharpshooter Medal

Take-down .22 Caliber Single Shot rifle. A low-priced, light-weight gun, made in two sizes

Winchester Marksman Medal

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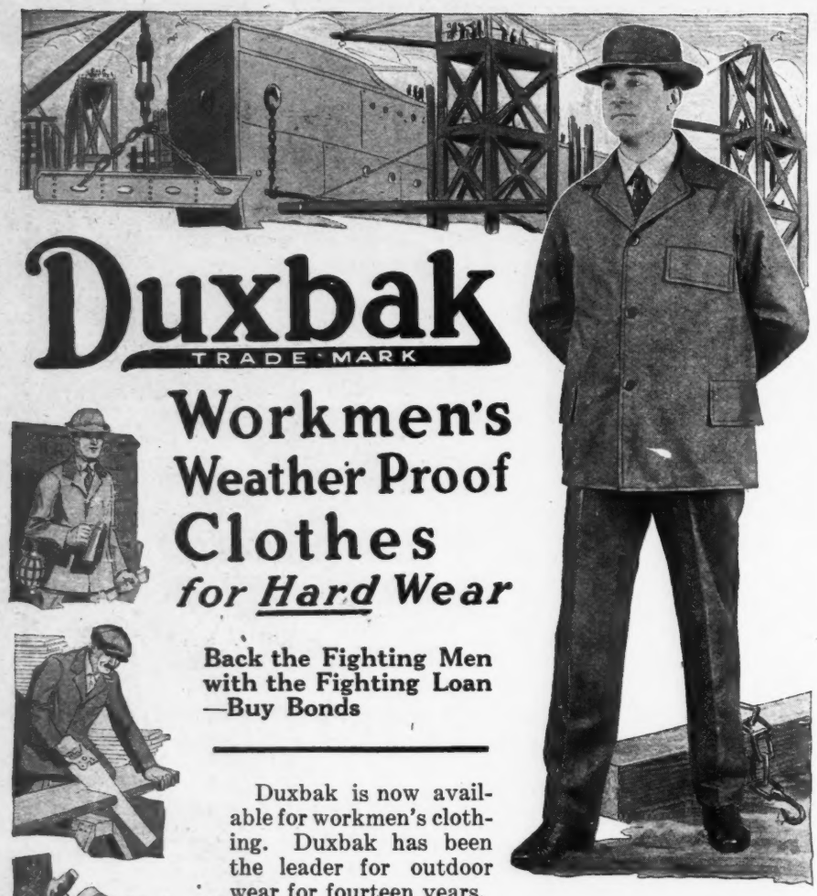
World Standard Guns and Ammunition



Duxbak
TRADE MARK

Workmen's Weather Proof Clothes *for Hard Wear*

Back the Fighting Men with the Fighting Loan —Buy Bonds

Duxbak is now available for workmen's clothing. Duxbak has been the leader for outdoor wear for fourteen years.

Duxbak replaces two expensive outfits—your wool suit and your overalls, and will outwear both.

Duxbak utility clothes are comfortable, durable and economical and stand hard wear; protect from wind and rain; can be worn to and at work—all year —except in extremely cold weather.

Made of specially woven, heavy duck fabric and *rainproofed.*

Just the right clothes for Ship Builders, Engineers, Farmers, Milkmen, Miners, Woodsmen, Railroad and Baggage men; for Drivers, or other outside workers requiring roomy, serviceable, *weather-proof clothes of moderate price.*

Coat is single breasted. Corduroy faced collar and adjustable corduroy faced cuffs. Entire body and upper half of sleeves lined with Duxbak cloth. Three large outside set-in pockets with flaps, and two large inside patch pockets.

Long trousers reinforced from hip to knee and at seat with Duxbak cloth; cut full and roomy; two side, two hip and two watch pockets with button flaps; belt loops. Trousers can be worn with or without leggings or puttees.

Many styles of Duxbak hats or caps to choose from.

Catalog No. 15 Free

Send for Catalog No. 15 with sample of material. Illustrates and describes full line of outdoor clothes—economical in price. Prices and measurement blank with catalog.

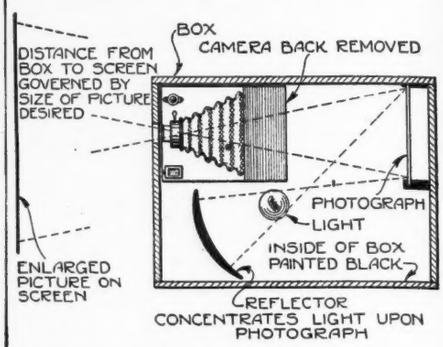
Utica-Duxbak Corporation

6 Hickory St., Utica, N. Y.

A Camera for Projecting Post-Cards on a Screen

IT is a very easy matter to use the camera which took your photographs to act as a stereopticon. Perhaps it might better be called a cameropticon. Anyhow you can cause it to project enlarged images of your favorite photographs, picture post-cards, etc., upon a screen.

Procure a box about 18 in. wide by 24 in. long and in one corner set your



Camera and box with light and mirror to make a post-card projector

camera with its back removed. When you have found just where the lens contacts with the side of the box, bore a 2-in. hole there. At a point 6 in. back of the camera, place the photograph held upon a support. Near the camera, but where it will not shine into its back, place a bright light with a reflector behind it to concentrate the glare upon the photograph intensely and evenly.

Take your cameropticon into a dark room, turn on the light, and you will find an image of your photograph upon the wall or screen provided. Use a 120 candle-power bulb. Or, better, use two smaller bulbs, one on each side of the camera, the camera being placed in the center of the box instead of in one corner.

Of course you will have to focus until the image is clear, just as in taking the picture. Paint the inside of the box black. The dotted lines show the path of the light rays.—F. E. BRIMMER.

To Remove a Tightly Fitting Can Cover

TO remove the cover on a round metal or paper container that fits tightly, place a stout string with the ends tied together so that the loop will fit loosely just below the cover edge on the can body, and then by means of a stick twist the string up very tightly. This will release the cover so that it will come off easily and quickly.

Twisting a wire on a can to remove its cover

Those Pictures from Home

"If they only knew the pleasure they bring us
* * * * I am sure they would come."

Translation of an extract from a letter written by a young Belgian soldier to a friend in America.

"And often I must take in my hand, the pictures from home. I look at them all, one after the other, and they speak to me. Then I am once more at home—I listen, and I live again. It would be too much for me to write you all that they say. But above all, they say to me '*Au revoir.*' I find them all a little thinner, and Father and Mother a little grayer of hair. *Tiens!* if they only knew the pleasure they bring us, these pictures from home, there would not be one remaining in Belgium. All the pictures would rush towards us; even if they had to pass through the electrified wire of the frontier, or if they had to swim through Yser Canal, I am sure they would come."

GUSTAVE GEBOERS

L 282 2me Compagnie Armée Belge en Campagne

IN THE FRENCH

Et chaque fois je dois prendre les portraits de chez moi en main. Je les regard tous, l'un apres l'autre et tous me parlent. Alors je suis de nouveau à la maison, je les ecoute et je revis, —ce serait trop de vous écrire, tout ce qu'ils me disent. Mais surtout ils me disent, "Au revoir!" Je les trouve tous un peu maigris, et Papa et Maman un peu plus gris de cheveux. Tiens, si seulement on savait le plaisir que nous procure, ces portraits de la maison, il n'en resterait pas un en Belgique. Tous les portraits s'elanceraient vers nous, quand même s'ils devaient passer les fils electrique de la frontière; ou s'ils devaient passer à la nage le canal de l'Yser, je suis certain qu'ils viendrait.

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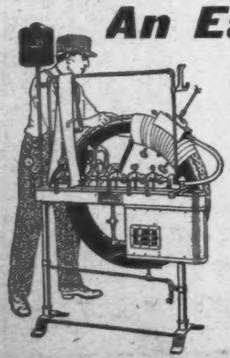

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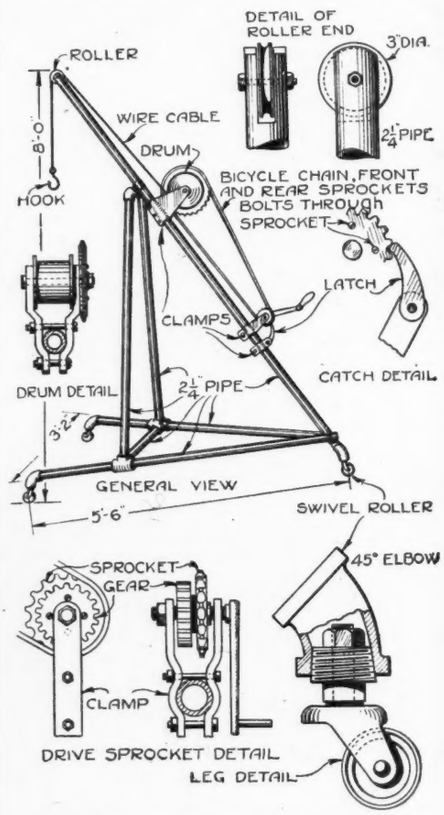
A Home-Made Portable Crane for Garages

A PORTABLE crane for a garage is one of the most necessary tools required. It provides a means for lifting motors, gear cases and other heavy parts from automobile chassis. The one illustrated is easily constructed of old iron pipe, bed casters, bicycle



A garage crane made from old iron pipe, bed-casters, and a bicycle chain and sprocket

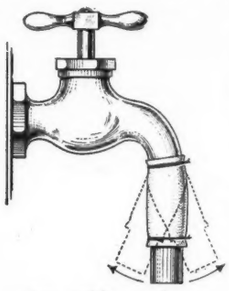
chain and sprockets and one crank and one gear, several pieces of band iron, a length of steel cable, a wood drum, old sash pulley at the top, nuts, bolts, etc. As this will weigh only 200 lbs. or possibly less, it is readily placed in almost any position and is a great help to all repairmen.

Detachable hooks of different sizes may be used so as to engage different size parts to be lifted. The connecting pipes of the frame are standard fittings bent to fit and drilled for ¼-in. bolts to give additional strength. The catch is made from a piece of band iron and also its clamp. To release the tension

or lower the article, press down on the handle, hold the latch or catch up, and allow the handle to reverse until correct height of article is found; then release the latch, which will hold the gear as before at any desired position.—P. P. AVERY.

Movable Stop-Cock End for the Sink Water Faucet

THERE is always a time while the sink is full of pots and pans when the water is wanted in one vessel and not in another. The turning of a stop-cock is quite a task when busy handling the utensils. A movable stop-cock end is more desirable in this case and very few would think that such an attachment could be applied to the regular cock. This can be done in the following manner:



The rubber swings nozzle to any angle

Cut a piece of pipe, of about the same diameter as the stop-cock and 1 in. long. Get a piece of rubber tubing about the same length which will make a tight fit on the pipe and stop-cock. Slip the rubber tubing over the pipe and stop-cock end, and wire it tightly in place.

A slight pressure of the finger against the end moves it at an angle so that it will permit the water to be directed exactly in the direction which is wanted.

When it is considered that in an average kitchen, something must be moved away from the stream of water from ten to twenty times a day, or from three to seven thousand times a year, it will become clear that the five cents and the ten minutes' time needed for adjusting it are a good investment.

In addition to doing away with all this shifting and moving, this arrangement permits the sink to be washed and rinsed out far more easily, as the stream can be played just where it is needed. And besides this the attachment does not interfere with anything; nor is it ever in the way of the user.—HENRY SIMON.

A Paste for Removing Ink-Stains on Silver

ARTICLES of silver in domestic use frequently become badly stained with ink. These stains cannot be removed by any ordinary process, but they readily yield to a paste composed of chloride of lime and water. In an emergency, Javelle water may be used with good results. Rubbing the article briskly with chamois cloth will give it as high a polish as it originally had.—HERMAN NEUHAUS.

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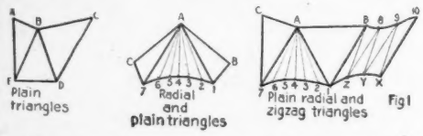
Simple Designs for Sheet Metal Working

XVIII.—Interesting Sheet Metal Patterns Developed by Triangulation

By Arthur F. Payne

Director of Vocational Education, Johnstown, Pa

THOSE of you who have been following this series from the beginning will have no great difficulty in developing these patterns, even though at first glance they may appear to be rather complicated. The illustration Fig. 1 is for the purpose of bringing before you more clearly the three types of triangles that are used when developing sheet metal patterns by triangulation. The plain triangles were made use of first; then the so-called radial triangles were used in combination with the plain triangles. These were shown in the August and September, 1918, numbers of POPULAR SCIENCE MONTHLY.



These diagrams show clearly the three types of triangles used to develop a pattern

In the problems illustrated in this issue we shall use the plain and radial triangles, and also, for the first time shall use the so-called zigzag triangles. The difference between the three types can be easily seen by studying the first sketch.

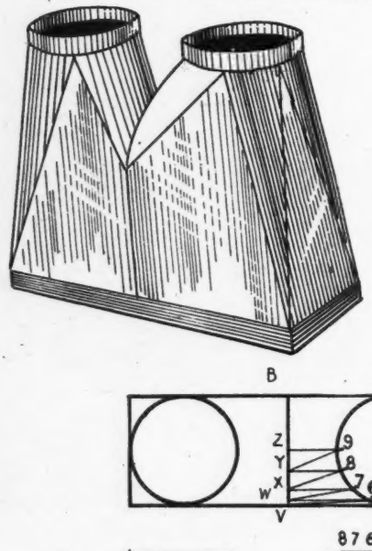
The triangles shown were all drawn at random, and are not a part of any pattern, the idea being to show the three types with the method of locating the points. Observe that the points of the plain triangles are located by letters of the alphabet; the points of the radial triangles are located by letters and figures; the zigzag triangles by letters and figures.

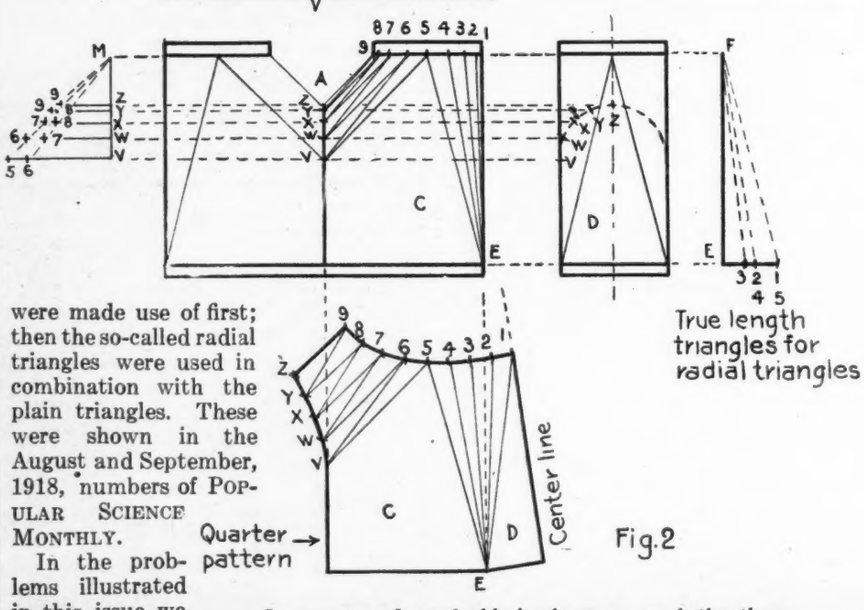
In problem Fig. 2 we use all three types of triangles. On the end we use the plain, on the corner we use the radial, and on the throat we use the zigzag.

How to Proceed

To develop this pattern, first draw front view *A* and top view *B*. Next lay off, as shown, the large flat surfaces, *C* on the front and *D* on the end, that need no development. We shall only need to develop one quarter of the complete pattern, as it will be seen that all four quarters are alike. Lay off the radial triangles on the corner by the usual method of dividing one quarter of the top view circle into four equal parts. Draw lines from these points to the corner *E* on both top and front view.

Start to lay out the pattern by drawing the large surface *C*. Find the true length of the radial triangle lines on the

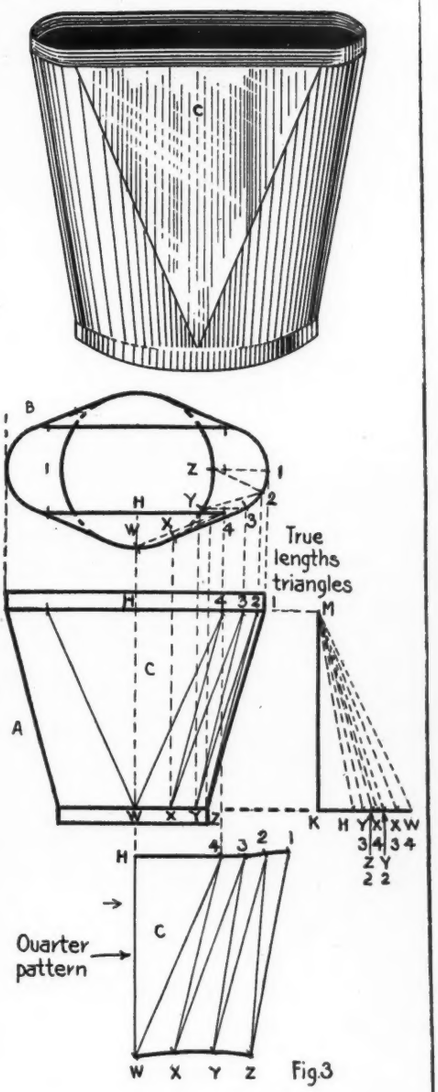




On a pattern for a double leg boot are used the three types of triangles—the plain, the radial, and the zigzag

corner from the true length triangles in the usual manner, or as follows:

On the base line from the corner *E* set off the distance of the numbered points of the top view circle from corner *E* of the top view; for instance, take distance *E*-4 of the top view and set it off as *E*-4 of the true length triangle. The dotted line *F*-4 is the true length of line *E*-4 of the front and



The same principles are applied in a different form for this problem

top views. Set this off on the pattern as line *E*-4, getting the distance between 5-4 from the top view of circle. In the same manner, lay out the other radial triangles and also the triangle *D*. If difficulty is encountered with this particular phase of the problem, it is suggested that a brief review of the problems in the last three chapters will make the process plain, as this part was explained thoroughly in those numbers.

The Zigzag Triangle

A new feature of this problem is now reached—the development of the pattern for the curved throat. It will be observed that we cannot lay this curved part out in large plain triangles or in radial triangles, as we have done

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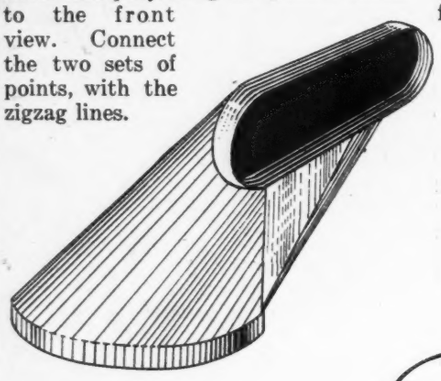
with previous problems, so we lay the part out in zigzag triangles. The method is as follows:

On the top view circle lay out the equally spaced points 6-7-8-9. Carry these points across to the center line, and mark them *V-W-X-Y-Z*. Draw the zigzag triangles as shown.

To lay out the front view of these triangles, project the numbered spaces down from the top view circle. To get the proper spacing for the points on the front view center line, we must draw the end view *D*, dividing the circle and projecting the points across to the front view. Connect the two sets of points, with the zigzag lines.



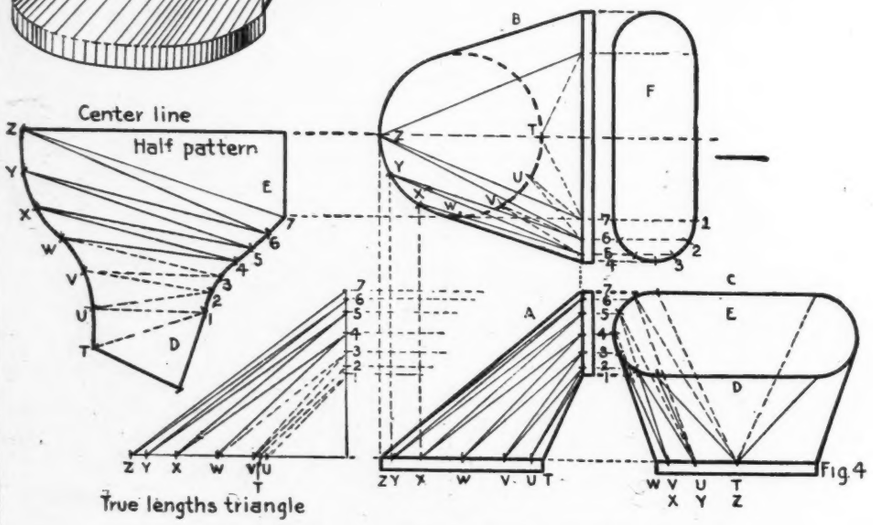


Fig 4

With this problem we encounter the most difficult development so far brought forth. While the drawing appears complicated, a study of preceding problems will aid in solving the lay out

We must think of these lines as the hypotenuse side of the triangles, as described in detail in previous chapters. We can get the length of the base from the top view and the length of the altitude side from the front, and then from these two lines get the true length of the hypotenuse. This is shown in the true length triangles at the left of the front view. The perpendicular line with the points *V-W-X-Y-Z* is the length of the altitude sides of the triangles; the lines running from these lettered points to the numbered points is the length of the base line of the triangles; the dotted lines are the true lengths of the corresponding zigzag lines.

The steps taken to lay out the pattern for the throat are as follows:

From point 5 on the pattern lay off point 6 as obtained from the top view circle. Now it is necessary to get the true length line *V*-6. Lay off *V*-6 from the top view as *V*-6 of the true length triangle, and the line 6-*M* is the true length of *V*-6. Lay off this as *V*-6 on the pattern. Next lay off *V-W* on the pattern as obtained from *V-W* of the end view *D*. Now it is necessary to get the length of 6-*W*. This is obtained by laying off line 6-*W* of the top view as 6-*W* of the true length triangles. The line *M*-6 is the true length, and is laid off as 6-*W* of the pattern.

Follow exactly the same method for the rest of the pattern. Only one quarter of this pattern is shown. The quarter pattern would be reversed to get one half, then repeated to get the full pattern.

In the problem Fig. 3 the same principles are applied to an entirely different problem—the round to an oval starter. First draw the front view *A*, the top view *B*, and lay off the large flat triangle *C*. Then lay out the zigzag triangles by dividing the two circles of the top view into equally spaced points and connecting them as shown. Project these points down to the front view, and draw the front view of the zigzag triangles.

To lay out the pattern, project the distance *H*-4 from the front view and draw the center line *H-W*. To get the correct length of *H-W* set off the distance *H-W* of the top view as *K-H* of the true length triangles, and the dotted line *H-M* is the true length of *H-W*.

Now lay off *W-X* on the pattern as obtained from the top view circle. We must get line 4-*X* for the pattern. To get this, set off distance 4-*X* on the top view as *K-X*4 of the true length triangle, the dotted line *M-X*4 is the true length of line *X*-4. Next lay off distance 4-3 on the pattern as obtained from the top view, and get the line *X*-3 for the pattern in exactly the same way as for *X*-4. Follow exactly the same steps for the balance of the pattern.

The ninety-degree round to oval single boot shown in Fig. 4 is the most difficult problem so far developed in

this series. The drawing appears very complicated, but if the reader has worked out the preceding problems, he will have no difficulty at all with this problem. It will be observed that the end view *C* is becoming necessary. If only the front and top views were shown there would be no way of knowing whether the oval end were rectangular or oval, so the end view is necessary to show that the end is oval.

The Most Difficult Problem Yet

Draw the front view *A*, top view *B*, and end view *C*, and lay out the large triangles *D* and *E* on the top and end views. Lay out the zigzag triangles by spacing off the large circle of the top view, projecting the lettered points down to the front view. On the end view *C* and the top view *F* space off the small circles as shown, and project the numbered points over to the front and top views. Connect the numbered points and the lettered points with the zigzag lines on all three views, as shown in the drawing.

To lay out the pattern, project over to the pattern the distance from the center line to 7, then draw the center line at right angles to it, and get the correct length of the center line by taking the apparent length of the line *Z*-7 of the front view. Notice that this is the apparent length of the line *Z*-7. It is really the true length of the center line, because the top of the line *Z*-7 is leading toward us. We next get the true length of the line *Z*-7 by laying off the distance *Z*-7 of the top view on the base line of the true length triangle, and the solid line *Z*-7 is the true length of *Z*-7. Next lay off the distance 7-6 of the end view, as 7-6 of the pattern; then get line *Z*-6 of the pattern by projecting point 6 from the front view to the true length triangle, and the solid line *Z*-6 is the length of the pattern line *Z*-6. Repeat with balance of pattern.

Explaining Solid and Dotted Lines

It will be seen that some of the zigzag lines in the front, top, and end views are solid and some are dotted. The dotted lines represent those lines that would be invisible if the boot were actually made of tin or sheet iron. For instance, if we were looking at the end view, and it were made of sheet iron with the lines drawn on the outside, we could see the solid lines, but not the dotted lines, the same is true with the top view lines. These are dotted lines connecting points 1-2-3 with *T-U-V-W*. These lines would be invisible in the view if the boot were made of metal. The lines that are solid or dotted in the top view are also drawn solid and dotted in the true length triangles and the pattern.

Several letters have been received from readers asking for the development of a ship's ventilator. This will be demonstrated in the next chapter.

(To be continued)

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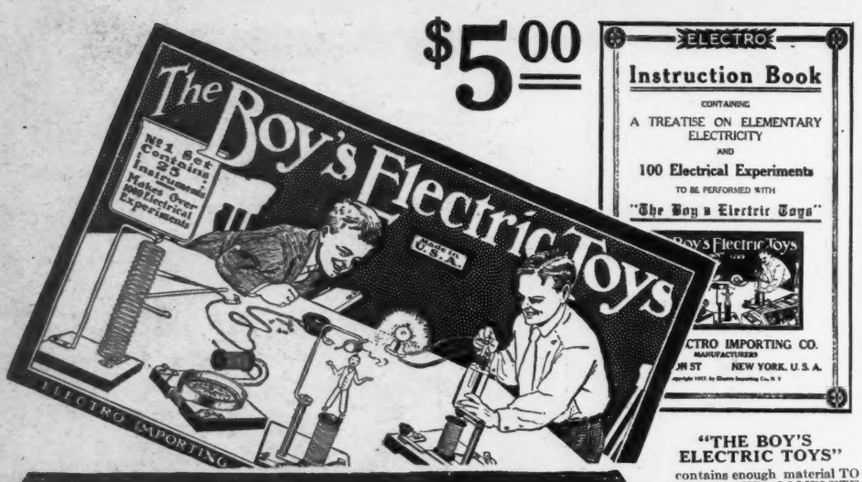

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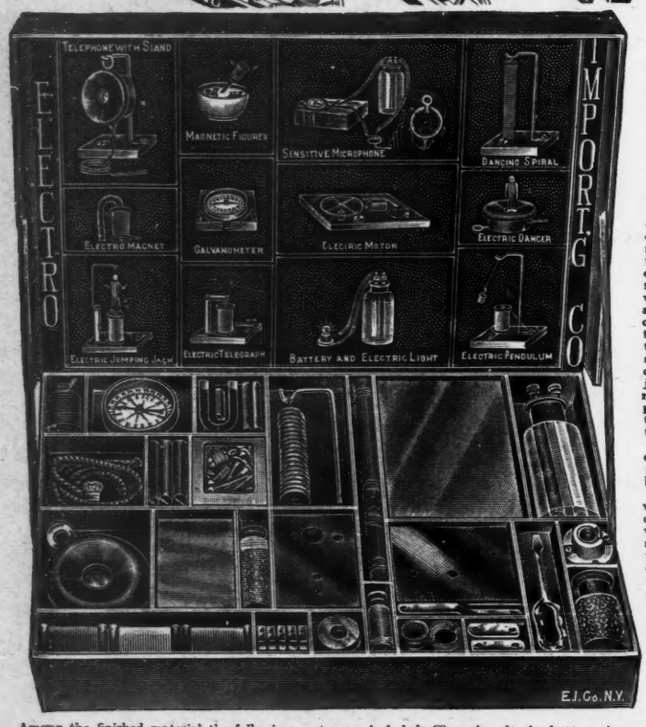

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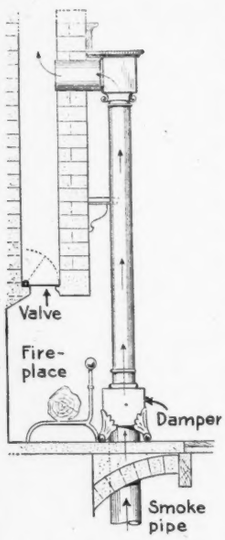
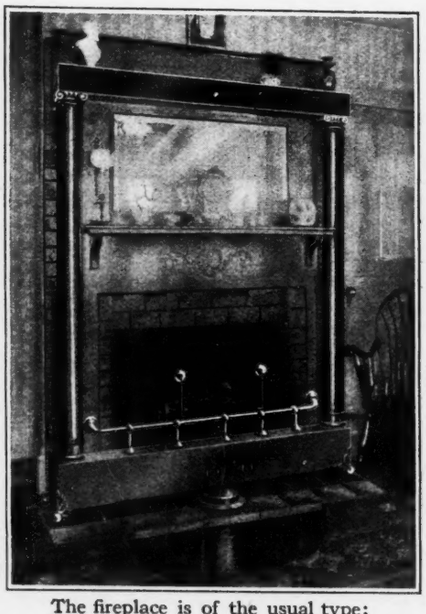
The Fireplace Dummy May be Made to Radiate Heat

TRUE fuel conservation consists not so much in scrimping on coal as in saving heat, a very large percentage of which goes straight up the chimney, doing no good. A dummy fireplace, of which there are many, may be arranged as shown in the illustration, through which the smoke and hot gases may pass on their way up from the heater below and be discharged into the chimney above the fireplace. Considerable heat will radiate from this dummy, sometimes enough to heat an entire room, and there is the novelty of the fireplace giving out heat with no fire in the grate.



Sectional view of pipes in columns

A tinsmith can build this of good, heavy sheet iron, using 3½-in. pipe for the columns. These will equal the area of a 7-in. smoke pipe, which is the usual size. The work may be decorated with sheet metal ornaments to any desired extent and will look well finished in bronze or old copper. The wall behind should be of brick or tiling as a protection against heat. There should be a damper in the bottom of the dummy to check the fire. There should be a valve over the top of the fireplace in the chimney to shut off the draft except when the grate is being used.—W. H. SARGENT.


The fireplace is of the usual type; the heat radiates from the columns

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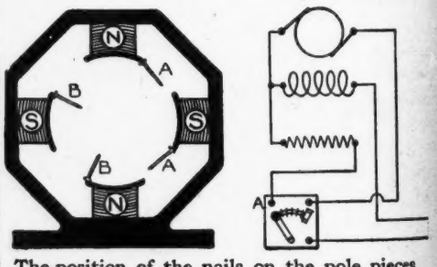
A leather piece over a draw-string hole

Testing the Polarity and Compounding of Motors

IT is necessary at times to test the polarity of a motor when a compass is not at hand. A simple method of doing this when the armature is removed is to use several nails or other soft iron pieces. The field circuit is closed and the nail placed at the edge of the pole pieces as in the illustration. Should the poles be in proper sequence nails will lie in the position shown at *A, A*. Should one pole be wrong the nails will stand out from the poles as shown at *B, B*. The remedy, of course, is to reverse the leads to the wrong pole, or should this be impractical due to the type of connectors used between field windings, the winding should be removed, turned end for end, and replaced.



The position of the nails on the pole pieces drawn by magnetic force designates the poles

The compounding of a motor may be easily checked in the following manner: Remove all load from the machine and loosen but do not remove the lead to the shunt field at the starting box. Start the motor in the regular manner and when it is running freely open the main switch; then quickly remove the shunt field lead from the starting box. The starter handle will have returned to the off position so

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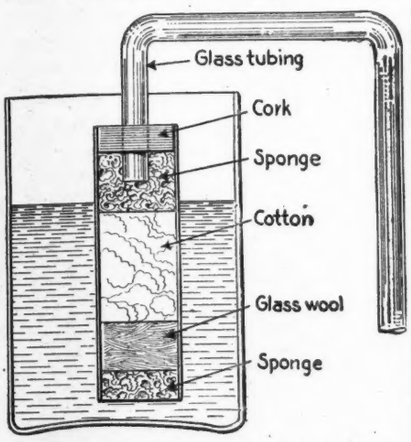
the main switch can be closed again. The machine will have continued running from its momentum. Watch it closely and just as it is slowing down to the stopping point, move the starter to the first point with the left hand and keep the right hand on the main switch. The machine will start as a series machine, and if it runs in the same direction as when the shunt field was connected it is compounded for motor; should it reverse its direction of rotation it is compounded for generator. When running with shunt field off the current draw is heavy, therefore, it should not be advanced beyond first point and open circuit at switch to prevent arcing at the starting box.—THOS. W. BENSON.

An Efficient Filter for Chemicals Is Cheaply and Easily Made

A SIMPLE chemical filter, yet withal an efficient piece of apparatus, can be readily constructed with materials found about the laboratory. A glass tube is bent twice at right angles, as shown in the illustration, so that the larger leg is about six times that of the shorter one. To the



A filter constructed on the inner end of the siphon leg, combining filter, and siphon

shorter leg is fastened, by means of a perforated cork, a glass tube which is much wider.

This short piece of tubing is filled consecutively with a small piece of sponge, absorbent cotton freed from grease and glass wool, and the end is stopped with a piece of sponge similar to the one previously used. The filter is started like any other kind of a siphon.—HERMAN NEUHAUS.

Remedying Frayed Ends of Shoe-Laces

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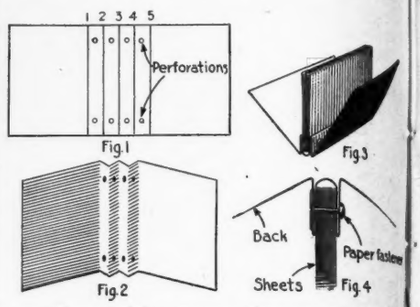
Binding Pages with the help of a Single-Piece Back

A PENNSYLVANIA printer used a single sheet for binding a number of pages as shown. The sheets were run through the press and scored with flat sides of five two-point brass rules for the folding lines. After



How to fold a heavy piece of paper to make a back of loose leaves

perforating and folding, the backs were applied and secured with brass fasteners. In Figs. 1 and 2 are shown the folding lines, perforations and folds. The completed work and method of fastening are shown in Figs. 3 and 4. This method makes a better appearing job than the two-sheet back and prevents wear on the back edges of the pages.—JAMES M. KANE.

A Clean-Sweep Broom for Outdoor Work

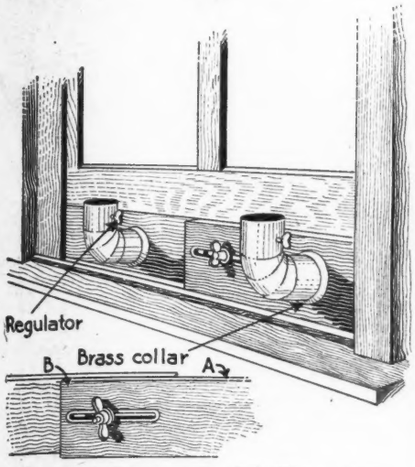
CUT from dead or old trees in the country about fifty or sixty of the thinnest branches, or twigs, each about 3 ft. long. Trim them so that they will make a neat, compact bundle, and tie just as tightly together as possible with very stout rope, keeping the cut ends closely joined. Then sharpen an old broom handle at one end so that you can drive that end down into the bunch of brush that you have tied together, and make your broom the right length for comfortable use. The sweeping end of the brush is left irregular, not trimmed. This makes a very thorough-sweeping broom for lawns, garage driveways, back yards, poultry yards, and so on; in fact, anywhere that speed and a good,

Small selected twigs tied together, with an old broom-stick for the handle

clean sweep are desired. The idea may be worked up by making a smaller bundle of finer twigs or branches, and placing them together more evenly for use in cellars, on porches, and so on. If the twigs are laid rather flatly and wired to a small piece of wood, a very creditable rug beater may be constructed. The cost is the best item in favor of this clean-sweep broom, since it is practically nothing but the labor of making same.—E. M. BRICKETT.

A Ventilator Which It Is Easy to Regulate

THE ventilator shown in the illustration is one that is used in the large local bank of a country place. It is made up in two halves, *A* and *B*, fitted with neatly shaped elbows, cut from sheet tin. The elbows are about



Pipe and elbows made of tin like a stovepipe, with wing dampers for ventilation

3 in. in diameter. A damper is provided in each elbow for regulating the air inlet.

A thumbscrew, working in a metal slide, holds the two parts in place under the sash.—JAMES M. KANE.

You Can Make This Package-Carrier for Your Bicycle

THE frame of the package carrier is made of strips of steel and the basket is of 16-oz. duck. The strips of steel are fitted to the front axle and extend upward above the front wheel where a spreader is fitted in and riveted. A broad hem is

A light metal and canvas package-carrier for the front wheel of the bicycle

stitched in around the upper portion of the basket part and a rectangular strip of steel placed in it. This is fastened at its center on the ends with a bolt and thumbnut. The upper ends of the strips are further braced by like pieces extending to the handlebars where they are fastened with clips and bolts with thumbnuts.—J. F. BURNAM.

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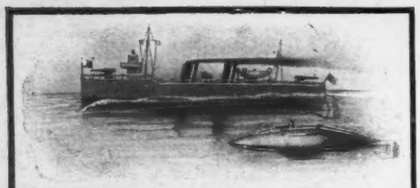

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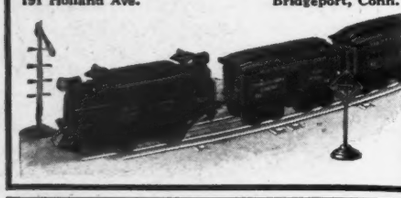

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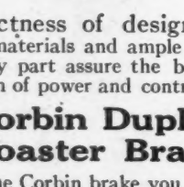

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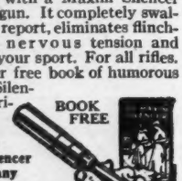
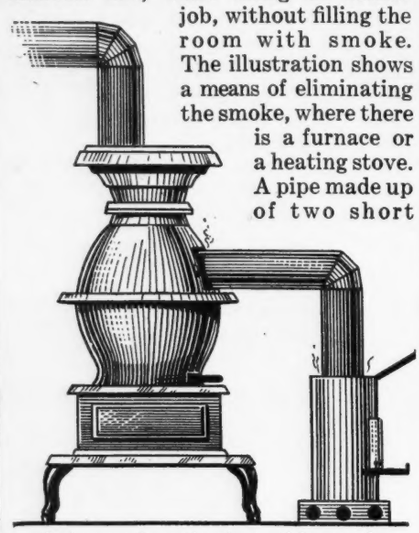


The Maxim Silencer Company
91 Homestead Ave. Hartford, Conn.

Arithmetic of Electricity—A practical treatise on electrical calculations of all kinds reduced to a series of rules. $1.00 *Postpaid.* Popular Science Monthly, 225 West 39th St., New York.

To Start a Charcoal Furnace Without Smoke

PLUMBERS and tinsmiths know the difficulties of starting their charcoal fire, when doing an indoor job, without filling the room with smoke. The illustration shows a means of eliminating the smoke, where there is a furnace or a heating stove. A pipe made up of two short

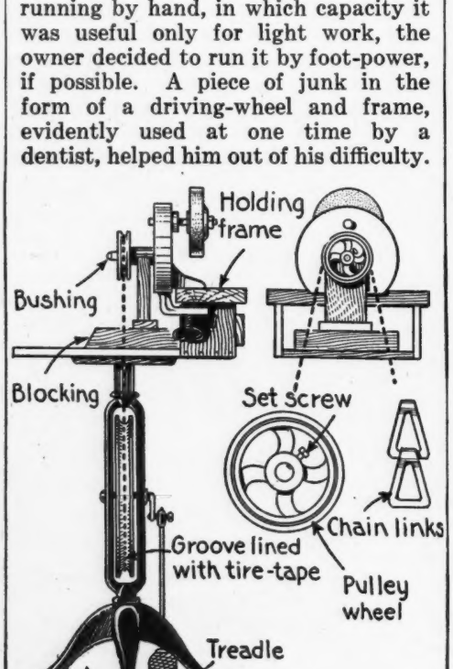


A pipe run from the charcoal furnace into the stove door to carry smoke away

pieces and an elbow is connected with the charcoal furnace and the opposite end of the pipe is run into the furnace feed opening. This provides a way for the smoke to pass out through the house chimney.—JAMES M. KANE.

Adapting a Hand-Power Grinder to Foot-Power

FINDING a small hand-power grinder to be inconvenient for running by hand, in which capacity it was useful only for light work, the owner decided to run it by foot-power, if possible. A piece of junk in the form of a driving-wheel and frame, evidently used at one time by a dentist, helped him out of his difficulty.



A hand-power grinder mounted on an old driving-wheel stand used by dentists

A wood top was fitted on to hold the grinder frame which was raised with wood blocks. After filing off the handle of the grinder the shaft was fitted with a grooved pulley taken from an old toy engine, which was

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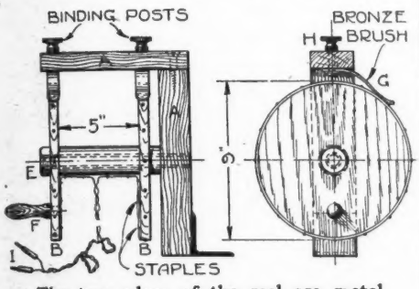
bushed with a brass fitting. An ordinary bathtub chain was used for the driving belt. To overcome the slipping of the chain in the groove of the driving-wheel, the groove was lined with tire tape. A neat iron support would have been better than the wood blocking, but even as it is, the change from hand-power to foot-power was very acceptable.—JAMES M. KANE.

A Reel for Winding Up an Electric Test Cord

THE following scheme was adopted to prevent a 50-ft. ground testing cord from becoming tangled. Two pieces of wood fastened as shown at *A* formed a stand, in which was drilled a hole that was a driving fit for a ½-in. pipe. Narrow strips of copper *B* were then attached, by small brads, around the circumference of both flanges of a small wire reel. A piece of pipe threaded on one end and cut long enough to extend through the reel, a small spacer, and the wooden upright, were then driven into place. After the spacer and reel were placed on the pipe, a ½-in. pipe cap *E* was screwed on the threaded end. The inner end of the test cord having been



The two edges of the reel are metal which makes connection with test wires

soldered to the under side of the metal strips, one wire to each strip, the wires were secured to the reel by small staples.

To facilitate winding, a discarded knife switch handle *F* was attached to the reel. Then two binding post studs *H*, to which two phosphor bronze brushes *G* were secured by nuts, extended down through top of wooden stand. On the outer end of the test cord were fastened two small hard rubber knobs *I*, Fig. 1, with a metal pin in the end.

Two live wires, having in series a lamp, were attached to the binding posts. If preferred, the lamp receptacle may be placed on top of the device.—L. C. ARNOLD.

A Waterproof Ink that Will Not Run When Washed

ANY ordinary ink may be made waterproof by mixing it with a little glue of the ordinary quality, care being exercised to ascertain the presence of impurities, which must be removed. After ink has been waterproofed in this manner, it is possible to wash drawings with soap and water, if necessary, without having the ink run.—HERMAN NEUHAUS.

Crying Need for $5,000 Men To Stop Traffic Losses

How to Qualify Easily and Quickly at Home

TRANSPORTATION is the second largest and most important business in the country. More than two billion dollars annually are spent in freight rates, yet it has been estimated that 8 out of every 10 shippers are losing money because of the scarcity of trained traffic men.

Every dollar wasted in freight charges represents a dollar of wasted profit or a dollar of wasted opportunity. In business today, freight charges are a vital factor in governing prices. By accepting every existent advantage in rates, a concern, or a city, can vastly undersell its competitors who waste traffic dollars.

A Few Reasons Why

A concern in South Chicago has been shipping about 200 cars of coke from Connellsville to their smelters. Some time ago a traffic expert succeeded in getting a rate adjustment which resulted in a saving of about $5.00 on each car. Thus, on this one item alone a saving of over $300,000 a year was effected.

In St. Louis, through misrouting of freight, errors in reconsigning cars and undercharges on shipments, a railroad lost over $27,000.

A traffic expert discovered that freight rates paid by the Meeker Coal Co. were exorbitant. A ruling secured from the Interstate Commerce Commission resulted in a refund of $122,000.

An oil shipper in Kansas was losing over $30 every day—$700 monthly—because he did not know of certain tariff regulations entitling him to lower rates.

These are but a few instances of what is occurring every day in the traffic industry. Tens of thousands of concerns, without realizing it, are losing fortunes every year because they do not know that there are countless classifications, special freight services and rate combinations which legally entitle them to rates that would amaze them if they but knew.

Is it any wonder that competent traffic experts are paid $2,500 to $10,000 and even up to $25,000 and $40,000 a year? Is it any wonder that firms are glad to pay a percentage of what traffic managers save? The man who can do it is in high command, and instead of finding himself in the position of even asking for a raise, generally has several firms bidding for his services. Why not? It's no hardship to pay a big salary out of losses turned into profit.

Your Life-Time Opportunity

There are about 50,000 large business corporations and about 400,000 smaller shippers which must be protected by competent traffic men. These concerns have freight expenses running from a few thousand dollars to many thousands of dollars monthly. Yet in the entire country there are only a few hundred men actually competent to have the money now being wasted through lack of efficiency in applying the Government Freight Rate System. It is estimated that over 100,000 more traffic experts are needed at once.

Heretofore there has been no simple way to master the details of traffic management. Realizing the crying demand for trained traffic experts and seeking relief, the American Commerce Association—a National organization OF traffic men, FOR traffic men, BY traffic men—offers to give men the training required to make them competent to handle the problems of most economic distribution. The training is given by mail, and can be studied in spare time at home. Though the most complete and thorough course is given, the Course is remarkably easy to master.

Through its Advisory Council, every member of the American Commerce Association receives the help of such men as T. Albert Gantt, traffic manager Corn Products Co.; Wm. Scott Cowie, general Eastern freight agent Erie R. R.; Samuel G. Lutz, general traffic manager Chicago & Alton R. R.; Chas. E. Mayer, traffic manager Stone & Webster Engineering Corporation; T. T. Harkrader, traffic manager American Tobacco Co., as well as nearly 200 others of equal prominence.

Startling Book Free

The Course of Traffic Management is adjusted to beginners as well as to those already engaged in traffic work. The instruction has been indorsed by such men as Robt. H. Forbes, traffic manager Butler Bros., New York; J. F. Brown, manager transportation department Chicago Board of Trade; H. G. Wilson, traffic manager of the Toledo Board of Trade; Ira S. Bassett, traffic commissioner Pittsburgh Commercial Club; W. H. DeWitt, Eastern traffic manager Western Electric Co., and hundreds of others equally prominent.

It is impossible to go into detail in this limited space, but the association has published a remarkable book for free distribution which explains the instruction in detail and tells how anyone may quickly learn the cheapest rates in existence on all kinds of shipments, the best methods of protecting shipments from loss and damage, and how to organize and manage a traffic department for maximum results. The book also tells what hundreds of other men have accomplished as a result of the study.

The new profession of traffic management is in its infancy. The possibilities today—great as they are—are nothing compared to what they will be a year from now. If you are at all interested in getting into the highly profitable field, paying salaries of $2,500 to $10,000 and more, be fair to yourself and write for the remarkable book now offered free by the association. In writing, please state whether you have had previous traffic experience, and give your present age and occupation. Address American Commerce Association, Dept. 911, 206 S. Wabash ave., Chicago, Ill. (American Commerce Building.)

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Tell us the best way of using an old automobile tire and win the first prize in the Popular Science Monthly Contest

WHAT do you do with your old automobile tires? Throw them away? Sell them to the junk-dealer?

We have seen old tires used as life-preservers. There must be other even more practical uses for them. We wonder what the ingenious mechanics and farmers throughout the country have done with their old tires—to what practical uses they have put them in the home and in the shop. Let them step forward and tell us. The POPULAR SCIENCE MONTHLY offers three prizes—a first prize of $25, a second prize of $15, and a third prize of $10—to be awarded in accordance with the rules published below:

Rules Governing the Contest

(1) Contestants are not limited to the number of methods of utilizing old tires which they may describe. But only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method of using old tires must be clearly shown either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol-board. The views should be sufficient in number to set forth the use of the tire very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method of utilizing the old tire is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P. M. on December 31, 1918.

(5) The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

(6) The first prize of $25 will be awarded to the contestant who, in the opinion of the judges, has suggested the simplest and best method of utilizing an old tire.

The second prize of $15 will be paid to the contestant who submits a method next in merit.

The third prize of $10 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of POPULAR SCIENCE MONTHLY. A description of the methods which won these three prizes offered will duly appear in the pages of the POPULAR SCIENCE MONTHLY, together with the names of the winners.

(8) The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious methods of utilizing old tires which do not win a prize. The regular space rates will be paid to the contestants who submit manuscripts on the methods thus selected.

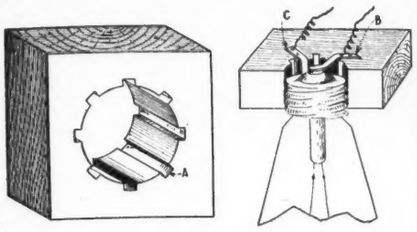
(9) When a contestant submits more than one method, the description and drawing by which it is set forth must be sent as a separate unit.

(10) No manuscripts or drawings will be returned to contestants unless enclosed postage is intact.

(11) Send drawings and specifications to the Tire Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.

Making an Electrical Socket from Wood and Strips of Brass

IN the construction of a homemade enlarging machine for photographs, a series of lamps placed close together was needed. The ordinary electric socket would not permit this close



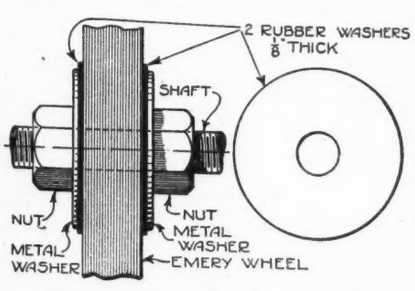
A wood block with a hole having metal inserts to make connection to the lamp

setting and the only other method was to make sockets in wood as shown. As these sockets proved very efficient, several single sockets were made for the shop with the same good results.

To make such a socket, bore a hole in the wood, a trifle smaller in diameter than the outside surface on the lamp base. When the lamp is turned in, the threads will be formed in the wood of sufficient size so that the lamp can be turned in and out as it can in an ordinary socket. The hole has a number of notches cut in with a scroll or keyhole saw as shown at *A*. Sheet brass connections *B* and *C* are fastened on with screws from the back of the sockets.—VIRGIL R. THARP.

Safeguarding an Emery Wheel with Rubber Washers

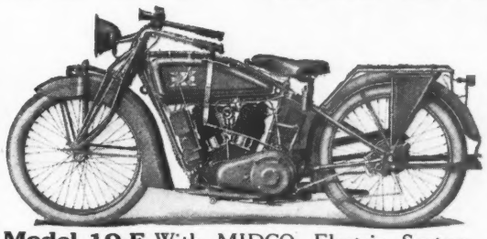
AN efficient but simple method of preventing the fracturing of emery wheels due to the excessive tightening of the nuts is shown in the illustration. The two rubber washers are cut from ⅛-in. sheet rubber somewhat larger than the outside diameter of the metal washers. A hole is punched through the center of each disk large enough for the shaft to pass through. One rubber washer is placed on each side of the wheel and then the metal washers and nuts are placed in



Rubber washers placed on the emery wheel sides prevent the wheel cracking

position in the usual way and then tightened up. Emery wheels rigged up in this way will be found to give better service and stand greater strains, because the rubber washers permit a certain amount of flexibility, although the wheel is firmly held in a rigid position.—FRANK W. HARTH.

1919 EXCELSIOR



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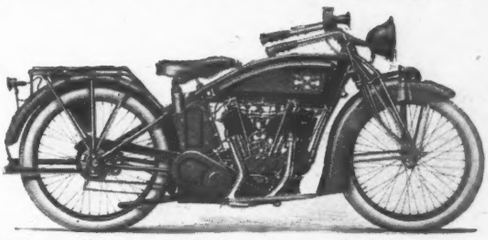

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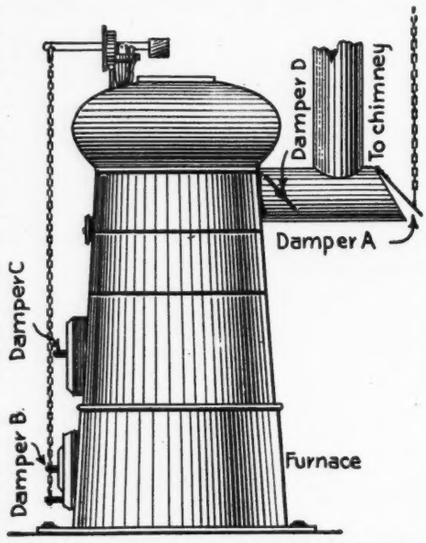
Five Ways of Saving Fuel in Heating Houses

IN house-heating equipment fuels that require little attention in burning are the most economical and give the best satisfaction. In time of war less desirable coal may have to be used, in order to simplify transportation problems; but the fact remains that some coals are more efficient than others when the same attention is given to the fire.

Usually the man of the house attends to the furnace early in the morning and again in the evening, while during the day the furnace is left in the care of the housewife or a servant. Since the housewife usually has children, the preparation of meals, and other cares to take up her time, she cannot give the furnace much attention. In some houses the furnace is attended only when the house becomes either too hot or too cold, and thus the fire is allowed to run from one extreme to the other—conditions that are very unfavorable for saving fuel. Therefore, in order that the fuel may be burned economically in a house-heating furnace, the fuel used should be of such a kind that the fire requires little attention. The following, in the order named, are the best fuels for house heating purposes.



This illustrates the location of the dampers used on the ordinary house furnace

Anthracite coal in sizes from ½ in. to egg-size. Gas retort or metallurgical coke in pieces ½ in. to 3 in. across. Coal briquets 2 to 3 in. in diameter. Screened Pocahontas —semi-bituminous—coal over ¼ in. and through a 3- or 4-in. screen. Sized bituminous coal in pieces ½ to 3 in. in size. If these fuels can be bought, fine sizes of slack coal or other fuels requiring frequent attention should be left for power plants where there are firemen to give the fire frequent attention.

Variety of House-Heating Fuels

Because of the great variety of fuels used for house-heating purposes, and because of the great variety of house-heating equipment and conditions of operation, only the most general rules can be given for firing the fuel. The details must be determined by actual trial in each furnace.

The conditions under which house-heating apparatus is used are difficult to meet. The temperature of a house should be kept uniform, with the firings far apart and with little attention given to the fires. The questions for each household to decide are: How much variation in the house temperature can be tolerated, and how much attention can be given to the furnace?

The kind of heating apparatus has a great deal to do with the uniformity of the house temperature and the amount of attention that must be given the fire. Hot-water systems will give more uniform temperatures, with less attention to the fires, than hot-air systems. No one set of rules will work satisfactorily in all cases.

When firing anthracite, the best results are obtained by spreading the coal evenly over the entire fuel bed. The fire should not be allowed to become too low before putting on a fresh firing. A fuel bed from 5 to 10 in. thick gives good results. The fire should be disturbed as little as possible.

Briquets, when properly made, are very good fuel for house-heating purposes. But the supply is very limited. When burning briquets the fuel bed should be kept from 8 to 12 in. thick. The fresh charges should be spread evenly over the grate area. The fire must not be disturbed. Poking breaks the briquets and spoils the fire.

The semi-bituminous coals of the Pocahontas type are good fuel for heating a house. They are nearly smokeless and make but little soot. For regular firing, the coal can be spread evenly over the entire fuel bed; or it can be fired like bituminous coal, the fresh charges being placed alternately on one side of the grate, and a part of the surface of the fuel bed left uncovered. The alternate method should be used if the firings are heavy. The fire keeps better overnight if the last firing is heaped to one side of the grate. Good results are obtained with fires from 8 to 10 in. thick.

Both bituminous and soft coals are smoky, and cover the flue surface with soot and tar, which reduces the transfer of heat and impairs the draft. Bituminous coal should be fired by placing the fresh charge on one side of the grate only, leaving part of the fuel bed uncovered. The volatile matter rising from the freshly fired coal is ignited by the red-hot coal of the uncovered part of the fire, and a large part of it burns.

If the entire surface of the fuel bed is covered with a heavy charge, the volatile matter from the fired coal does not ignite for a considerable length of

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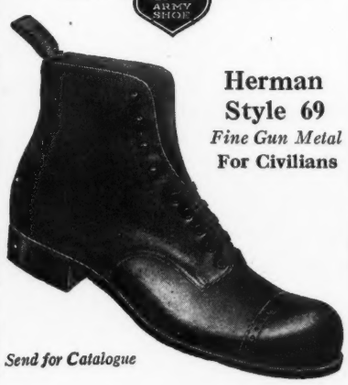

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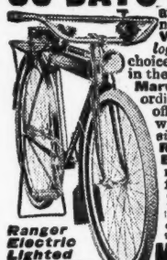

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time after firing, and passes away unburned as a tarry, greenish-yellow smoke. The furnace and the flues become filled with the smoke, and when the fire finally works its way through the fresh layer of coal the smoke and the gases may ignite with an explosion violent enough to blow the pipes down and fill the house with smoke. These explosions are particularly apt to happen if the coal contains much slack; therefore with such coal particular care should be taken that part of the bright fire remains uncovered. This method of firing reduces the amount of soot deposited in the flues, so that less frequent cleaning is necessary. It also reduces the heat losses from incomplete combustion, thus directly effecting a saving of coal.

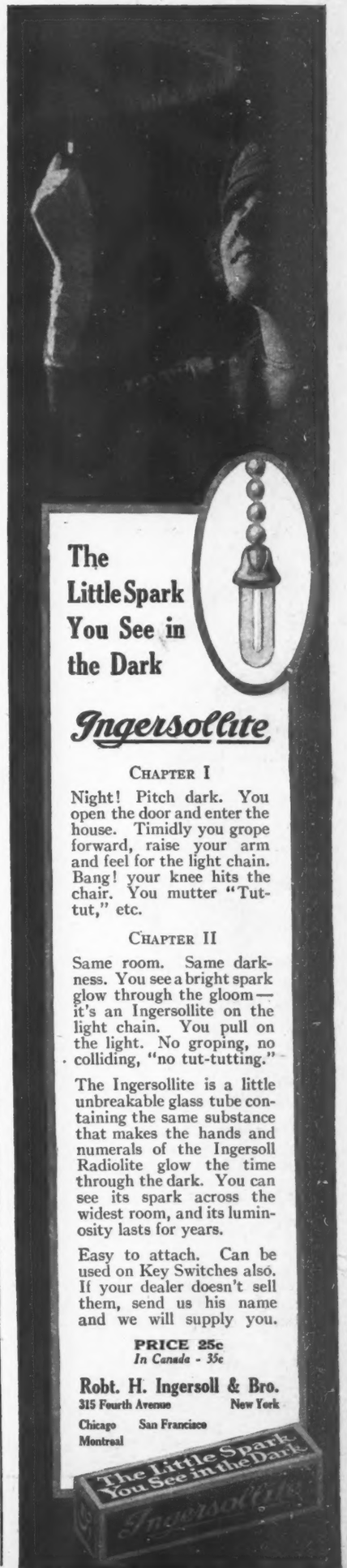
To Regulate the Drafts

Draft regulation is perhaps the most important factor in burning coal efficiently in house-heating furnaces. The draft is regulated mainly with three dampers. One of these is on the ash-pit doors, one on the firing door, and one in the pipe connecting the furnace with the chimney. For many furnaces the damper in the flue-pipe is an opening covered with a hinged lid (see *A* in the illustration). When this lid is closed, the full chimney-draft is effective in the furnace. When the lid is lifted, the chimney draws air from the cellar instead of drawing the gases out of the furnace, and the draft in the furnace is reduced to almost nothing. Between the two extremes any draft can be obtained by proper adjustment of the lid.

The damper *B* on the ash-pit door regulates the flow of air through the fire, and the amount of air flowing through the fire determines the rate of combustion, or the amount of coal that the furnace can burn in one hour. Therefore, to control the rate of combustion and thereby regulate the amount of heat the furnace delivers to the house, the furnace attendant adjusts the damper in the ash-pit door and the damper to the chimney.

The damper *C* in the firing door supplies air over the fire needed to burn the gases rising from the fuel bed; therefore its regulation controls the completeness of combustion of these gases. When soft coal is burned, a large volume of combustible gases rises from the fuel bed immediately after the firing; therefore the damper in the fire door must be opened enough to allow the air necessary for burning the gases to enter the furnace. After the smoky gases cease to rise from the freshly fired coal, the quantity of air supplied over the fuel bed can be reduced by partly closing the damper in the firing door. There should be a damper (*D*) in the smoke-pipe. This damper can be used in addition to the damper *A* to control the draft.

No rule can be given for the exact adjustment of the dampers. The proper adjustment must be ascertained


The Little Spark You See in the Dark
Ingersollite
CHAPTER I
Night! Pitch dark. You open the door and enter the house. Timidly you grope forward, raise your arm and feel for the light chain. Bang! your knee hits the chair. You mutter "Tut-tut," etc.
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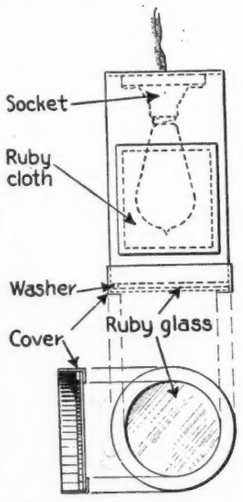
by trial. With a little care and some patience, the proper adjustment of the dampers of any furnace can be determined. In general, to make the fire burn more quickly close the lid *A* in the pipe leading to the chimney and open the damper *B* in the ash-pit door. To make the fire burn more slowly, raise the lid in the check-draft *A* and partly close the damper *B* in the ash-pit door. The damper *C* in the firing door is more difficult to adjust, because there is no way to determine the completeness of combustion. In burning soft coal, this damper should be slightly open all the time. In burning hard coal or coke, enough air for complete combustion may enter the furnace through various leaks, even when the damper is completely closed.

Handy Dark-Room Lamp Made from a Tin Can

A SUBSTITUTE for the modern electric dark-room ruby light may be easily constructed from a large tin can similar to those in which apples are put up for the market. Cut a rectangular hole in the side and place a piece of ruby cloth over it, binding it close to the opening with twine.



Bulb inclosed in a tin can with red light

The cover should also be removed and a round hole cut in its face, leaving a narrow rim around the edge. Place a close fitting piece of ruby cloth or glass inside and hold in place with a spring wire ring.

The bottom of the can should then be cut out in the same manner and a solid wooden disk substituted in its place. Tack the edges of the tin to it. The inner face of the disk should be fitted up with a light socket, running the wires through holes in the disk to the outside where they are used to suspend the light.

Fit a 6 C. P. bulb in the socket, put on the cover, and turn on the light.

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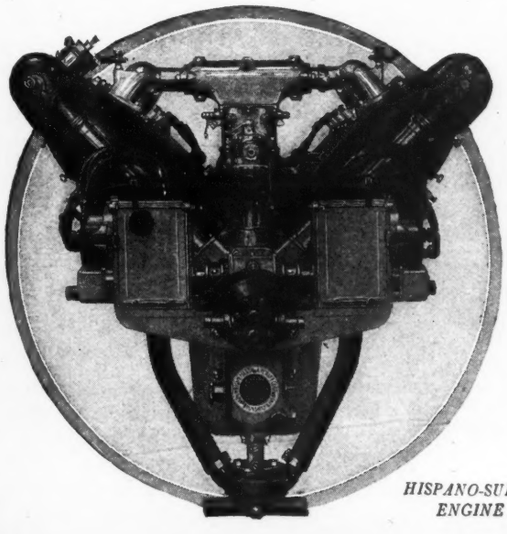

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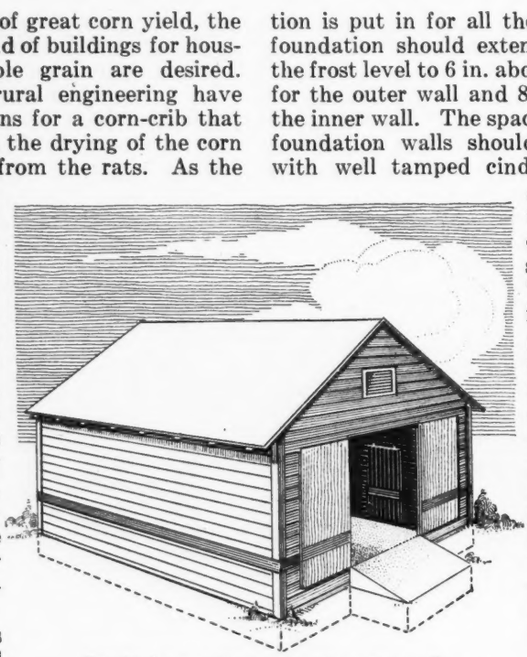
How to Make a Corn-Crib Rat-Proof

With the advancing prices of cereals, corn has became valuable and must have proper housing

IN these days of great corn yield, the very best kind of buildings for housing the valuable grain are desired. Specialists in rural engineering have worked out plans for a corn-crib that will both aid in the drying of the corn and protect it from the rats. As the accompanying drawings show, there are really two cribs in the complete structure, each 32 by 8 ft., with a capacity for 1,000 bushels. If desired, however, only one of the cribs may be built at first, and the construction of the other put off for a more convenient time.

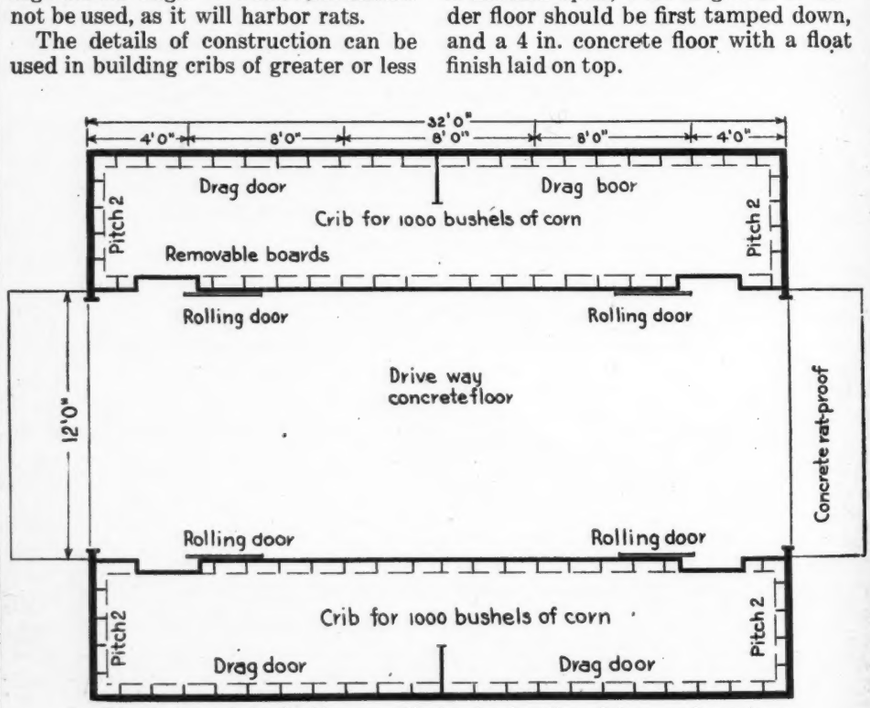


Double corn-crib showing the rat-proofing on the sides and the concrete driveway

The two cribs are separated by a driveway 12 ft. wide, and the whole is covered by a gable roof. The driveway floor may be made of either concrete or dirt. If the ground is well drained a dirt floor in the driveway will answer very well. If the floor is of concrete, it can be used for a feeding floor for hogs. A wood floor should not be used, as it will harbor rats.

The details of construction can be used in building cribs of greater or less dimensions or of a different type. The devices for ventilating and rat-proofing can be used in new cribs or in remodeling old structures.

As the plan shows, a concrete foundation is put in for all the walls. This foundation should extend from below the frost level to 6 in. above the ground for the outer wall and 8 in. above for the inner wall. The space between the foundation walls should be filled in with well tamped cinders or gravel and on top of this base a concrete floor should be laid. The difference in height above ground between the inner and outer concrete foundations will give a 2 in. pitch to the floor toward the edge, and will thus drain off water that may beat through the walls of the crib. The cinders or gravel beneath the floor will prevent moisture rising from the ground through capillary action. The floor itself should be constructed of 4 in. reinforced concrete, with the surface troweled to a smooth finish. If a concrete driveway is decided upon, 6 in. of gravel or cinder floor should be first tamped down, and a 4 in. concrete floor with a float finish laid on top.



Detail plans of the double corn-crib showing location of doors and openings to remove the corn by the load or into a conveyor to a corn-sheller

The iron sockets or joist hangers, which can be readily obtained in the market, should be set in while the concrete floor is being laid. As the drawings show, the studs should be

2 by 6 in. To these is nailed siding for the outer walls. This siding consists of 1-by-4-in. boards with both the upper and lower edges beveled at an angle of 5 degrees. They should be set about 1½ in. apart. This permits free entry of air, while the beveled edges lessen the danger of rain beating into the crib.

The beveled edges are not absolutely necessary. In the complete structure the siding on the walls facing the driveway need not be beveled, since there is no necessity for protection from rain here. On these sides, too, the siding boards should not be carried higher than 6½ ft. This permits the crib to be filled by throwing the corn over the boards. If the quantity of corn on hand is sufficient to fill the crib above this point, additional siding boards can be hung on 20d nails or spikes driven into the inner side of the studs. The boards may have holes at intervals to fit over the spikes. The boards are held in place by the pressure of the corn.

How the Rat-Proofing Is Made

The rat-proofing is an important feature of the design which the farmer cannot afford to neglect. Wire mesh netting of ½-in. openings is put on all sides of the crib between studs and siding, and carried to a height of 30 in. above the ground or above the floor of the driveway. At the top of the wire a strip of 8-in. galvanized iron should be nailed to the outside of the siding.

The bottom of the galvanized iron is 2 in. lower than the top of the wire, making a total height for the wire and iron strip of 36 in. all around the outside. This galvanized strip will halt any rats that may climb up the walls. The rat-proofing is put on the drive sides of the crib, so that if the doors are left open rats will still be unable to get at the corn. Care should be taken not to leave any objects near the walls which would enable the rat to jump above the rat-proofing.

Provision is made for four drag doors on the outer side of each crib and two rolling doors on the inside. The drag doors are so designed that corn will roll out of them on the conveyor belt of a sheller. The rolling doors on the inside are for access to the crib. They should consist of a frame completely filled with the wire netting and with a galvanized strip the same height as for the walls. The drag doors are made of siding nailed to cleats with the wire mesh between.

Movable inverted troughs of slats are placed on the floor lengthwise of the cribs. These are in sections to facilitate handling, and are designed to increase the circulation of air through the corn. As a further aid to the circulation of air, movable shafts may be placed at the side or top of the troughs. The shafts are constructed of 1-by-3-in. vertical strips nailed to frames made of 1-by-2-in. stuff.

Can You Answer these Questions on Shop Work?

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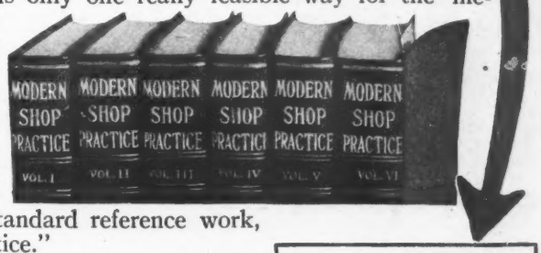

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A surface of cast iron is to be finished in one cut on a milling machine. The casting is 8 inches long and 5 inches wide. The milling cutter has a diameter of 3 inches and a width of 2 inches. How long will it take to do the work? Assume a feed of 2½ inches.

For what purpose is a magnetic chuck used?

How many processes for cutting gear teeth?

How do you determine the ratio of two gears, when the numbers of teeth are given?

The lead screw has a pitch of ¼ inch. What is the ratio of gears to be used to cut a screw with 18 threads per inch?

What determines the cutting speed in a milling machine?

Give a short description of the thermit-welding process.

What is essentially the first step in making any tool from a toolmaker's standpoint?

Why is it advisable to cut the threads of an adjustable tap somewhat smaller than the desired size for the tap to cut?

Under what circumstances would you consider it advisable to use a counterbore, rather than a drill when enlarging a hole? Why?

Why should undue accuracy never be indulged in when making drill jigs and similar tools?

What is the practical way to test the temper of molding sand?

How does the riser on a steel casting differ from one for iron?

What are some of the precautions necessary in pouring a mold in order to obtain the best results?

How are the sides of deep molds vented when a flask is used?

What point carbon steel should be used for machine tools, milling cutters, drills and taps?

Why is it necessary to reheat large pieces after they have been hardened?

What must be the outside diameter of the original wooden pattern for the rim of a pulley with six arms, the diameter of the finished pulley to be 30 inches and the width of face 9 inches?

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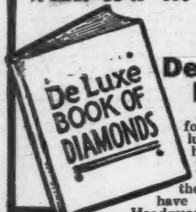

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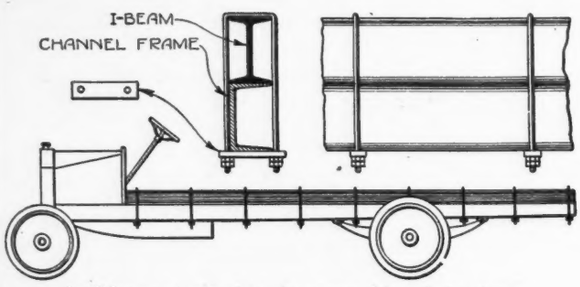
Reinforcing Motor-Truck Frames for Heavy Loads

A MULTITUDE of motor trucks, including several makes operating on lumber and ore hauls, have had their frames broken by overloading and traveling over rough roads. Some have been repaired by welding; some by having raw stock machined to fit the channel of the frame to which the stock was riveted overlapping the crack; others were trussed.



An I-beam attached to the upper sides of the channel frame of an automobile to strengthen it

One truck which operated on a lumber haul, under severe conditions regarding roads and overloading, had its frame broken in three different places during one season and had undergone two of the methods of repairing mentioned without success. Afterward the same frame was reinforced by the method described below and the truck was operated throughout the season without any frame trouble.

All equipment mounted on top of the frame from the dash- to the tailboard was removed, including the cab, seat and gasoline tank. Two 7-in. I-beams were placed on top of the original frame and cut to the proper length. They were then secured to the old frame by means of U-bolts forged from round stock to the shape shown, each leg being threaded about 2 in. from the end. A cross-piece was made from rectangular stock for each U-bolt.

The sags in the old frame were leveled up as near as possible by means of jacks and the bolts applied, as shown in the cross-section. Each leg was provided with two nuts and the bolts were spaced from 1 to 2 ft. apart, varying according to the equipment mounted on top and below the frame. The I-beam was slightly wider than the original frame, which necessitated chiseling a small piece out of each side of the I-beam at the point where the U-bolts were located. This brought both legs of the bolts to a flush fit with both the old and new frames and prevented any side motion when the truck was in operation. When the two beams were securely fastened to the old frame the gasoline tank, seat and cab were slightly reconstructed and mounted upon the new frame, as was also the other equipment used in the truck's particular service. By this method of reinforcing, the load was raised 7 inches.—H. W. OFFINS.

Spikes Make the Most Serviceable Tent Stakes

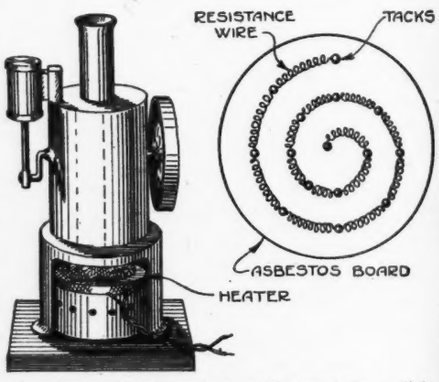
CAMPERS and others who "tent out" will spare themselves much labor and aggravation by providing themselves with a few large spikes used for the holding of any wood framework instead of using tent stakes. The spikes never need any sharpening and may be driven into the hardest ground with little difficulty. They will hold with as much security as wooden stakes, and are readily pulled up when breaking camp.

Such spikes may be purchased at any hardware store for 1 cent each, and if wiped up with oil at the end of a camping trip, a set of them will last indefinitely.—JOHN EDWIN HOGG.

An Electric Heater for a Toy Steam Engine

THE alcohol lamp furnished with toy steam engines require constant refilling and, because of this disadvantage, they are dangerous for small boys to handle. It would probably be worth while for "big brother" or "Dad" to rig up this simple electric heater to replace the alcohol lamp in the little steam engine. It may some day save burnt fingers or possibly a life.

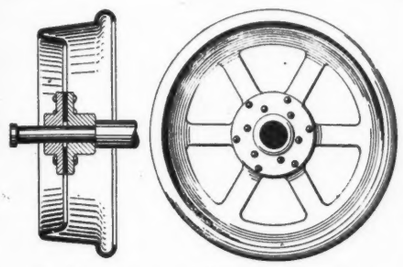
A circular piece of asbestos board is cut so it will fit snugly in the fire box directly under the boiler. A few feet of some good resistance wire is then coiled around a small round object such as a ⅛-in. rod. This is done in order to crowd a sufficient amount of wire in a small space. After the wire is slipped off the rod, it is arranged on the asbestos board as shown. The two ends of the wire are then connected to a lamp cord through the board and the whole thing is permanently fixed in the fire box so that the heating coil will come within ¼ in. of the bottom of the boiler. A safe and sane method of heating the boiler in engines is thereby made possible. —RAYMOND FRANCIS YATES.



An electric heating element fastened to a disk of asbestos for making steam in the toy engine

Making Flanged Steel Wheels in One Piece

A FEW years ago one would have scoffed at the idea of a car wheel made of a piece of 3/16 or ¼-in. sheet steel that formed the web and tread and flange all in one. But such a thing is now seen in daily use on hand cars, motor cars and much of the other



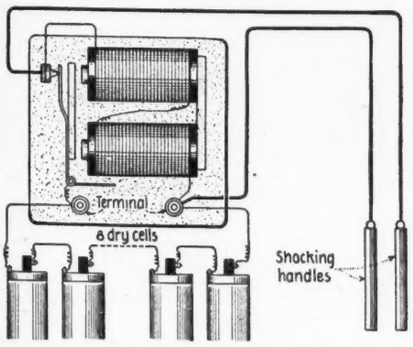
Design of a car wheel made from a sheet-metal plate and a cast-iron hub

auxiliary rolling stock found on standard gauge railroads.

The illustration shows one of these wheels in section. A single piece of sheet metal is "blanked out" to the required size. Then it is taken to powerful presses where, in several operations, it is shaped so that its outside contour is that of recognized standards. The advances of the pressed steel process and the unusually rugged presses developed have made possible what was formerly but a theory. The wheel is not a quarter as heavy as a cast wheel, but it is amply strong and safe; no turning of tread and flange is required, for they come true from the press, thereby saving on the labor cost. To provide a stable bearing for the axle, a hub and hub flange are riveted in the center. Sometimes the web is further lightened by punching out portions and making it spoked.—D. A. HAMPSON.

The Ordinary Buzzer Used for a Shocking Machine

THE accompanying illustration is self-explanatory. The buzzer connected up as shown with eight dry cells in series may be employed to give



Attachments to an ordinary buzzer to made an electric shocking machine

a fairly large shock. The shocking handles may be made from round battery carbons, if metal ones cannot be secured. The shock may be intensified at any time by wetting the hands with salt water.—HERMAN NEUHAUS.

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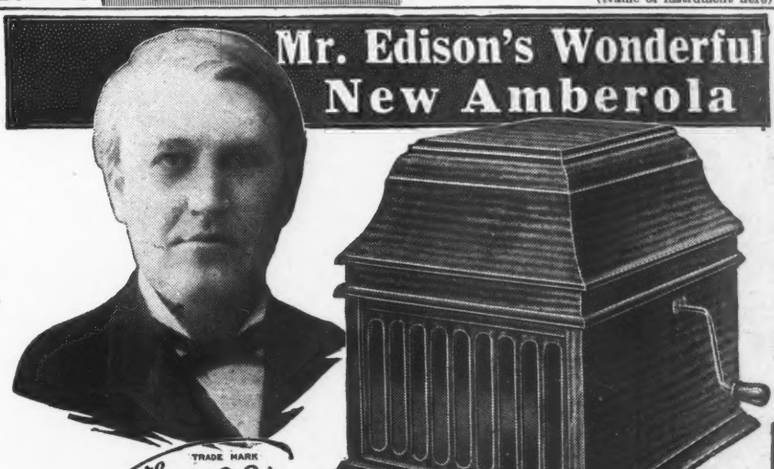

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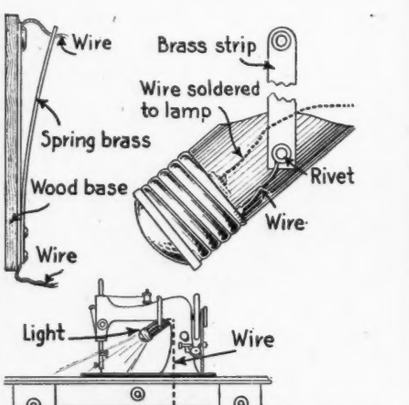
Procure an old cylindrical hand flash-light and cut it at the proper angle so that when placed against the under side of the machine arm as shown, it will point directly at the "presser-foot" and the needle. Cut as short as practical so it will not interfere with the work. By trimming to fit the curvature of the machine arm it will make a snug joint. Bind it to the arm with two straps of brass,



A part cut from an old flash lamp and attached to a sewing-machine head to light the work under the needle

one end of each riveted to the fiber walls of the light. The top ends are drawn together with a small bolt just as with a hose clamp. The ferrule of the light is then wired to one rivet and a wire is soldered to the tip of the lamp base and brought out and carried down the arm of the machine.

Construct a switch similar to that shown in the picture and attach it to the body of the machine near where the left knee is naturally held. Ground one pole of the switch to the framework of the machine and lead the wire from the light to the opposite pole. See that the spring of the switch arm is strong enough to resist any ordinary pressure of the knee, but not so strong as to make it a tiresome job to hold it in contact for the few moments when light is desired. Set a cell of battery in the line in a convenient position and the outfit will then be entirely complete.—L. B. ROBINS.

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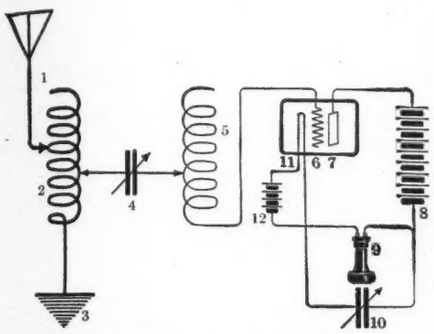
A Device to Amplify Weak Wireless Signal Impulses

AN invention to increase the sensitiveness of detecting methods in order to amplify the impulses of weak signals in wireless telegraphy has been introduced by Elmer E. Bucher. Employed in the device are means by which the maximum potential obtained from a certain amount of energy derived from the signals is impressed on a detector, preferably of the multiple-element valve type. The circuits are associated in such a way that the secondary contains an inductance which is relatively large, being the greatest possible for a given wave-length and a relatively small capacity. The coils making up the inductance have a natural period about equal to that of the oscillations received. It is preferable to ground the secondary circuit at points remote from the terminal of the detector to which connection of the secondary circuit is made.



Showing connections and operation of a device to amplify weak wireless impulse

The accompanying drawing shows the invention as it is used with wireless telegraph receiving apparatus. In the illustration the aerial is indicated by 1 and a coil by 2. The coil can be employed as an aerial tuning inductance and as the primary of an oscillation transformer. The earthing point of the aerial is indicated by 3. At 5 is the adjustable inductance in the secondary circuit, this circuit being of such high inductance and low distributed capacity that a large rise of voltage is caused at the end terminating in the detector. The coil of the inductance, 5, is connected to the earth through a point in the coil, 2, and by means of a small variable condenser, 4. The coil, 5, may also be inductively coupled to the aerial. The variable condenser, while not essential to the operation of the invention, adds to the results obtained.

Contained in the multiple-element valve detector, which should be in the form of a sealed vessel, is a plate element, 7, connected to a battery, 8, and a telephone, 9. A condenser, 10, may shunt the last-named instrument. The other terminal of the indicating instrument is connected to the circuit which includes the filament element, 11, of the detector. Connected to the filament is a battery, 12, which

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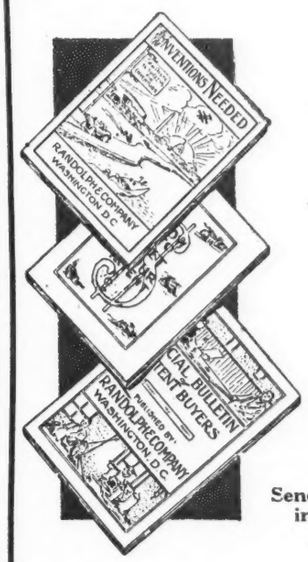

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properly heats the former.

In order to operate the device, the inductance of the aerial circuit is adjusted so that it is in resonance with the signals received. Maximum sensitiveness is induced in the detector by adjusting the batteries and the condenser. A response is obtained in the telephone by adjusting the capacity of the variable condenser and the length of the coil, 5.

There are several modifications of this method of using the apparatus. The device can also be employed in wireless or wire telephony, or wire telegraphy.

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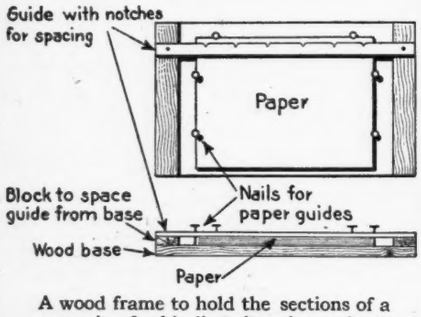

A wood frame to hold the sections of a magazine for binding them into a book

come between the jaws. Then give it another squeeze to make a tight bind.

For the cover use the front and back of one of the original books, since a paper cover is much more convenient than cardboard. Trim the front and back to the size of your book, then glue the edges over the pins on both sides. Cut a strip of heavy white paper about 2 in. wide, and glue on the front and back cover to make the book complete.

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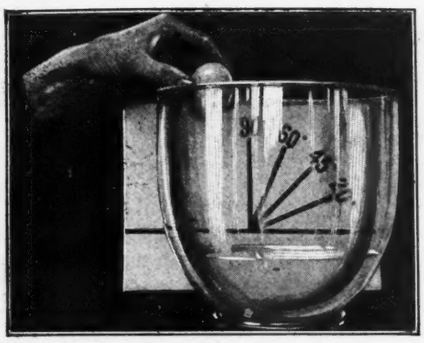
The Age of an Egg Told by Its Angle as It Lies in a Solution

NOWADAYS when so many folks are interested in poultry keeping it is well to know how easy it is to tell the exact age of an egg. Most people are aware that, in the thicker end of each egg, there is an air space. As the days pass by this space increases in size owing to the fact that the moisture from the egg evaporates through the pores of the shell. This loss of density makes it possible to arrive at the age of any egg by specific gravity. In the first place, a solution of salt and water is prepared—one part of the former to two parts of the latter.

The egg behaves in this liquid according to its age. Any time up to thirty-six hours after it was laid the egg will sink in the salt solution and lie horizontally on the bottom of the vessel. When two or three days old the egg rises to the surface and floats with a small portion clear of the water. There is to be noted a tendency on the part of the thick end of the egg (where the air space is) to rise upwards. As the days go by this tendency increases progressively. In eggs four or five



The angle at which an egg lies on the surface of the water tells its age

days old the long axis (an imaginary line drawn through the center lengthwise) is at an angle of 20 deg. from the perpendicular. At the end of the eighth day it is 45 deg.; on the fourteenth day it is 60 deg.; on the twenty-first day 75 deg.; whilst in four weeks the egg will be standing quite upright in the liquid.

To show clearly the angle at which the egg is floating is quite easy. A card is prepared with a scale of degrees ranging from 0 to 90 deg., the latter representing the perpendicular. If the eggs to be tested are placed in a glass jar the scale of degrees can be held behind and, in this way, a good idea is obtained of the angle at which they are floating.

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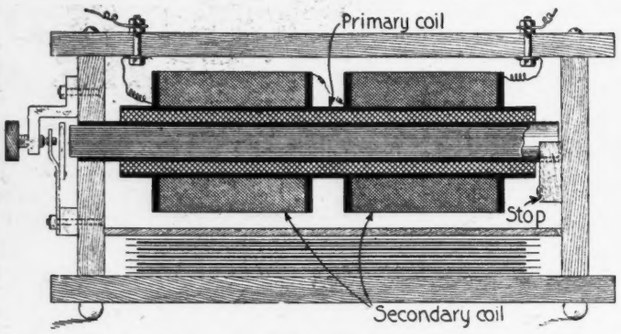
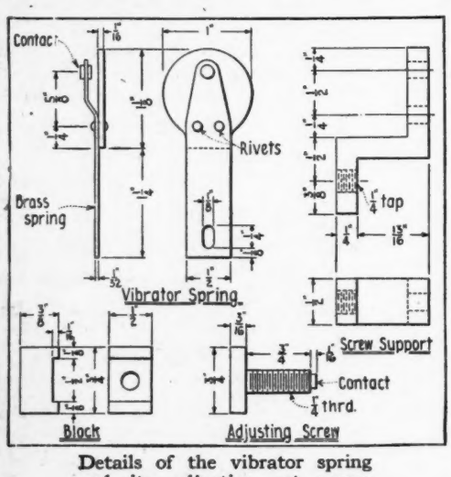
The Construction of a Two-Inch Spark Coil

THE coil described herein is rated as a 2-in. spark coil when operated on a 10 to 12-volt storage battery. The first part to construct is the core of iron. A thin paper tube of 1 in. outside diameter and 10 in. long is tightly filled with soft annealed iron wires. No. 18 gage wires, 10 in. long are used. The wires should be pushed into the tube so that when completed the core will appear to be almost solid. A coat of shellac is then given to the tube, and when it is dry, two even layers, 8 in. long, of No. 14 gage double cotton covered copper wire are wrapped on 100 turns to the layer or 200 turns in all. The tube is again shellacked, and a thin fiber tube 1⅜ in. inside diameter and 8 in. long is placed within.



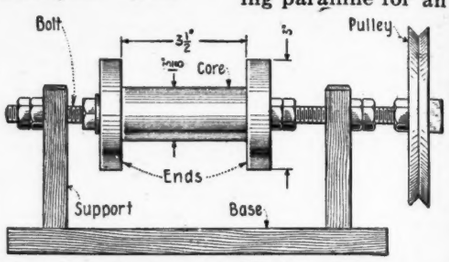
General plan of a two-inch coil, in its box, which is shown cut in half



Details of the vibrator spring and its adjusting set screws

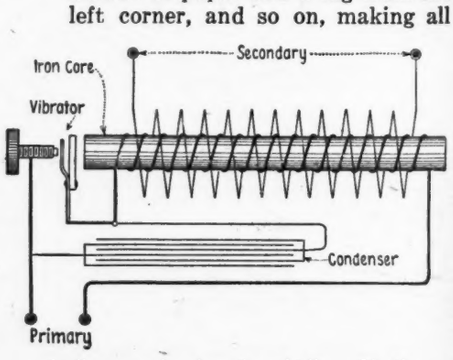
The secondary coil is made in two sections or windings connected in series. The best way of winding these sections is to make the winding machine illustrated. Two wooden disks 3 in. in diameter, having cores 1⅜ in. and 3½ in. long are rotated by a length of threaded rod. These parts and a pulley are fastened to the rod with nuts, as shown. The whole is then carried on suitable supports. A small battery motor, or a water motor, can be used to furnish the turning power.

The secondary is wound with No. 34 enameled wire. Each of the sections will require 1½ lb. of the wire. The layers should be wound on evenly and smoothly. Place two layers of thin waxed paper around the core of the winding spool and then wind on a layer of the wire evenly; cover this with a single layer of the paper, then another layer of wire, and so on until 1½ lb. of the wire is used. The layers of wire should be only 3 in. in length, but the layers of paper should be 3½ in. in length, therefore the ends of the paper will lap over the ends of the wire layers ¼ in. at each end. After two coils have been constructed they should be immersed in boiling paraffine for an hour until all the air has been expelled and the wax has taken its place. When dry they should be placed over the fiber tube containing the core and primary winding. The two coils should be so connected that the induced currents flow in the same direction in both coils. The proper connection is best found by experimenting until the proper spark length has been obtained.



The device on which the coils are wound to make the layers even

The condenser is made of sheets of tinfoil separated by sheets of paraffine paper. Cut out 100 sheets of tinfoil, 6 by 8 in., and 100 sheets of paper 7½ by 10½ in. On a sheet of paper, place a sheet of tinfoil and make a corner connecting lug ½ in. wide and 2 in. long projecting from the left corner. Lay on another sheet of paper and a sheet of foil and a connecting lug this time from the right corner, then a sheet of paper and a lug from the left corner, and so on, making all connections alternately to the right and then to the left. When the pile is completed, there must not be any electrical con-



A diagram showing the winding of both coils and connections to the condenser

nections between the right and the left projecting connectors. Press the condenser between two warm plates of iron until the paraffine in the paper becomes softened and the whole is stuck together. Immerse the finished condenser in boiling paraffine and then allow it to cool.

A box is next made of ½ in. oak to a suitable size for holding the parts. The inside of the box should be approximately 4 in. high, 6¼ in. wide and 8½ in. long. The condenser should be placed in the bottom and covered with a sheet of glass to prevent sparking between it and the secondary coils. As illustrated in the sectional view, the iron core supports the coils and is in turn supported at the back of the box with a block while in the front of the box is a hole through which a part of the core projects. This end of the core should extend ¼ in. beyond the surface of the box.

The success of the coil depends largely on the interrupter. One can be either made or purchased. The one in the illustration can be made and will work very well. The vibrator consists of a spring 2½ in. long, ½ in. wide and 1/32 in. thick, cut and bent to the shape indicated. It carries the iron disk to which it is riveted, as shown.

The end of the spring is supported by a brass block, a bolt passing through the spring, block and box. The contact is platinum-iridum rivet, which can be purchased at any electrical supply house. The adjusting screw is of brass with a ¼-in. thread cut on its end. A small hole is drilled into the end and the platinum-iridum contact point is set in and clamped in place by crimping the sides of the hole over it. The adjusting screw-bridge or support is of brass. It is fastened to the box with screws or bolts, in such a position that the screw makes contact with the spring.

The parts are connected as shown in the diagram, shunting the condenser around the vibrator points. The coil is tested to see if the secondary connections are correct. When it works satisfactorily, the box is filled with melted paraffine. Two binding posts connected with the terminals of the secondary windings should be placed at suitable locations on the top of the box, and two other posts for connecting the primary to the battery should be placed at the sides of the vibrator.

Protecting a Small Drill Where Much Pressure Is Applied

WHEN drilling a hole with a very small drill, upon which it is necessary to apply a good deal of pressure, run the drill first through a block of wood that is as thick as the length of the drill minus the depth of the hole to be drilled. Hold the block stationary while drilling. The drill can not bend in the wood and much more pressure can be applied than if the drill were unprotected.

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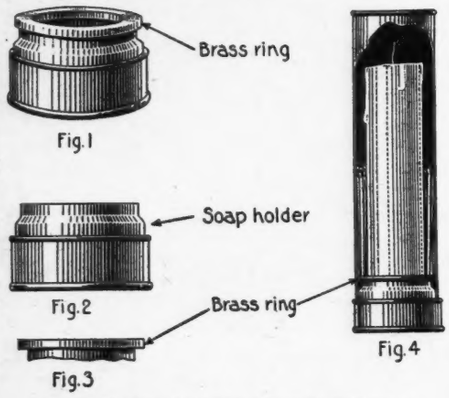
A Combination Candle- and Match-Holder

NOTWITHSTANDING the popularity of the handy flashlight, mechanics—and others—still find the primitive candle indispensable at times. It sometimes happens, however, that a candle is at hand but no matches. Herewith is illustrated a good candle-case, holder and match-safe combined. It can be easily made from a shaving stick case by soldering a brass ring or fitting (Fig. 1) small enough to hold the candle, into or onto the base (Fig. 2) of the holder. A section of brass like Fig. 3 is better than a plain ring. Procure a case having a soap-holder of brass. Aluminum, which is now being sold for the soap-holder section, is difficult to solder and will not answer the purpose on that account.—JAMES M. KANE.



A candle case, holder and match safe made from the ordinary shaving stick case

Mosquito Netting for Reinforcing Roof Repairs

ORDINARY mosquito netting as an auxiliary to paint and putty in repairing leaks in a tin roof appears to be unreasonable; yet it does contribute materially to the strength of the repairs.

A leaky seam in an old tin roof had been puttied so often that it looked like a golf bunker. Every time the weather grew warm the tin expanded and cracked the putty. Looking about for some reinforcing material to strengthen the putty, a repairman decided that mosquito netting would be just the thing.

The old putty was cleaned off, and a new coating, thinned sufficiently with paint to permit it being smeared on with a brush, was applied upon this surface, the netting laid on, and dabbed into the putty with a stiff brush somewhat in the manner of using a stencil brush. When thoroughly dry the repair was given a coat of paint. The job was done so well that no repairs have since been necessary.

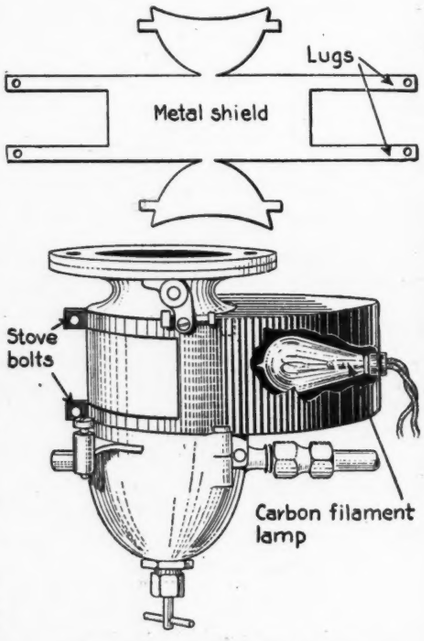
Frequently putty will fall from metal surfaces because it has nothing to grip. The mosquito netting, laid on a base of paint, affords it something to fasten to, particularly if the surface is irregular.

Heating the Carburetor of an Automobile

ONE of the simplest ways to start an automobile during cold weather is through application of heat to the carburetor. Most appliances to perform this particular duty are complicated and costly. The following device, which can be made by the amateur workman, will be found easy to construct and wonderfully efficient.

Cut out a metal shield, somewhat after the pattern shown in the sketch. The shape and size depend upon your particular make of carburetor but the drawing gives a general idea of what is wanted. Bend the two short lugs in to form shoulders and then fit the longer lugs around the body of the carburetor, tightening them in place with small stove-bolts. This will leave the shield projecting away from one side about 2 in. Bend the top and bottom panels in place, forcing the small lugs inside the shell.

After the shield is properly fitted, take it off and secure a lamp socket to the inside so that the bulb, when in place, will bear close to the carburetor. Use a carbon filament lamp as it gives the maximum amount of heat. Lead the wires from the base out through holes in the sides; being careful to insulate them from the metal. When all is complete, put the shield back in place and wrap the whole apparatus with thin asbestos paper. Then bind it on with fine wire.



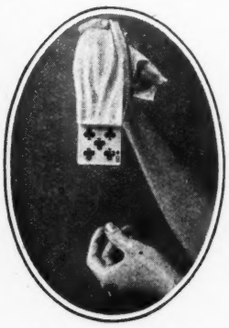
Metal shield to hold an ordinary electric globe close to the carburetor

Connect the wires with the storage battery of the car and with a convenient switch on the dash.

In the severest weather, this device will insure sufficient heat to start an automobile with but very little delay.—L. B. ROBBINS.

Trick of Drawing a Card from a Pack in a Handkerchief

A PACK of cards is shuffled and an ordinary handkerchief examined. The cards are wrapped up in the handkerchief and the parcel held by the extreme finger tips. The performer says he wishes to use the "eight of clubs" or some other card for a special trick and commands the card to come out. He gives the handkerchief a couple of slight shakes and the card slowly makes its appearance, seeming to come right through cloth and all.



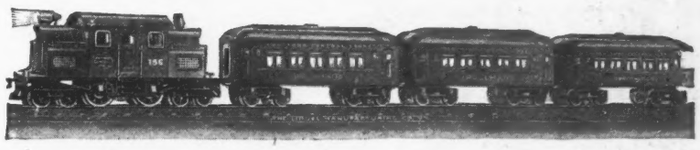
The card as it slips from the pack

To do this trick you have one card prepared by making the "back" of the card the same color as your table-top. For example, if you use a green baize card-table have the back of your card covered neatly with a similar cloth. Then when lying face downwards on the table it will not be noticed. After the handkerchief has been examined, open it out flat on the table over the "invisible card." Place the shuffled pack face upwards in the center of the outspread handkerchief. Then, first fold back the forward half of the handkerchief so that it will cover the cards. Next fold over towards the center both right and left sides of the kerchief. This leaves it in a triangular shape. Pressing the parcel down on the table, fold the two wide ends of the kerchief beneath the cards incidentally picking up the "invisible card" in these folds. It will make a regular pocket when the kerchief is held up, as in the illustration, for the pack of cards, being heavy, will keep the folds rigid. A slight shake or tap and the card will come through. Instead of matching a table top, the feat can be done with a newspaper.—MERRITT HALE.

How to Weigh a Finger Ring on a Large Platform Scale

A MAN who wanted to find the weight of a gold ring, and who had at hand only a large platform scale, found the weight of the ring in the following manner:

He stood on the platform, and balanced the beam by moving the runner, which showed 145 lb. Then, while still standing on the platform, he placed the ring on the hanger where the weights are placed, and moved the runner back until it balanced again. This time the runner was standing at 144 lb. The ring on the hanger stood for 1 lb. on the platform, which has a ratio of 100 to 1. Therefore the ring weighed 1/100 lb.—A. H. OKUN.



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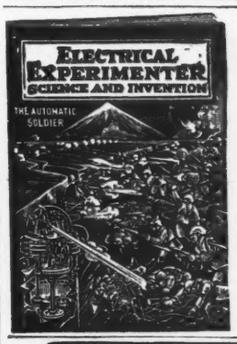

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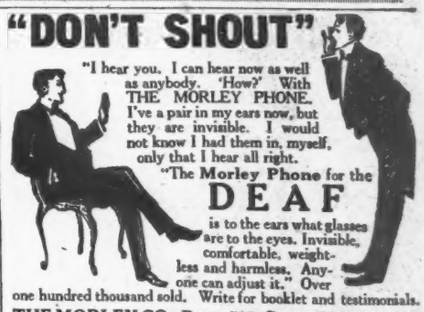

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Electric Devices and How They Work

XI—Principal Types of Current Rectifiers

By Peter J. M. Clute, B. E.

WHILE a very large percentage of the electrical energy now available from central stations is generated in the form of alternating current, many applications of electrical power require direct current, therefore direct current must be available from the distributing system, even though alternating current is required for transmission. In order to effect this change from alternating current into uni-directional or pulsating direct current, a current rectifier is used. There are a number of classes of apparatus to which the term rectifier may be applied, namely, electrical rectifying machines; electrolytic rectifier; mercury-vapor arc rectifier and electromagnetic rectifiers. The first type delivers direct current as shown in Fig. 1.

The conversion of high-voltage alternating current to low-voltage direct current is effected in two ways: First, the high tension alternating-current power is transformed into alternating current of lower pressure by means of step-down transformers; then, the low-tension alternating-current power is converted into direct-current power at a suitable voltage by means of rotating machines, which may be of either the two following types: the motor generator, and the synchronous converter.

The motor-generator converter consists of an alternating-current motor mechanically coupled to a direct-current generator. This is the most flexible type of converter and is adaptable to the greatest variety of conditions.

The synchronous rotary converter is a single machine, both receiving and transmitting electrical energy, and is a motor and generator combined in one. Viewed from its commutator end, this machine is a direct-current generator; from the other end, it appears to be a synchronous motor with revolving armature. If it is driven by mechanical power, it may, if properly excited, give out electrical power in the form of either direct, or alternating current or both at the same time. Under its various phases of operation, therefore, the rotary converter may run as a direct-current motor, direct-current generator, synchronous motor or alternator. In any event, its performance becomes that of one of these machines or a combination of them, and may be viewed in that light.

A comparison shows quite well the conditions under which either of these two types can be operated economically. The rotary converter is usually employed, but the motor-generator is preferable under certain circumstances. The motor-generator shows excellent flexibility and continuity of operation under fluctuations in voltage. The rotary converter, being a synchronous machine, may fall out of step under such voltage variations, and must be synchronized again before it can continue its operation. Furthermore, the motor-generator possesses an independent direct-current voltage control; the direct-current end of the set being electrically separate from the alternating-current end, the direct-current voltage can be varied without corresponding variation in the alternating-current pressure. In addition, by using a high-voltage motor, the motor-generator set may be connected directly to the high tensions mains without the necessity of step-down transformers. Under ordinary conditions, however, the synchronous converter is much to be preferred to the motor-generator set. Its low first cost and its high efficiency, together with the little amount of attention necessary recommends its selection. Furthermore, it requires only a small amount of floor space, and since it consists of but one machine, the windings and moving parts are less in number, thus rendering renewals and repairs less frequent.

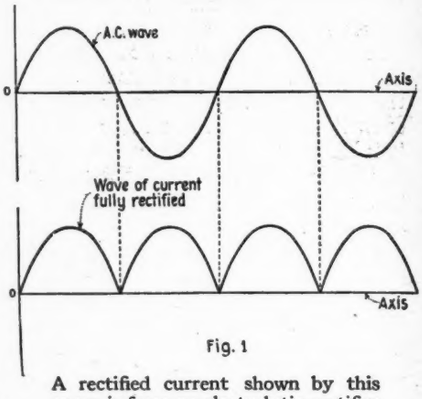

Fig. 1

A rectified current shown by this curve is from an electrolytic rectifier

The principal type of electrolytic rectifier is the aluminum-vale rectifier, shown in Fig. 2, the operating principles of which are as follows:

If two metals are placed in an electrolytic and then subjected to a definite difference of pressure they will under certain conditions offer greater resistance to the passage of a current in one direction, than in the other direction. On account of this so-called "valve effect," electrolytic rectifiers are sometimes called "valves." Metals of low atomic weight exhibit the valve effect at high differences of pressure, and heavier metals at low differences of pressure.

In the aluminum valve rectifier use is made of the principle that aluminum electrodes in certain solutions will allow current to pass through them

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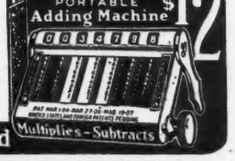

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in only one direction, namely, inwardly from the solution. Hence, aluminum can only be used as cathode, to which current flows within the rectifier. Two aluminum plates and one of lead are immersed in a neutral ammonium-phosphate solution. The lead plate is the anode from which current flows within the rectifier; iron and polished steel are also sometimes used as anodes. Referring to the diagram, the aluminum plates are each connected to the secondary terminals of a transformer, and the lead plate or anode is connected to one terminal of the battery to be charged. The other terminal of the battery connects to the mid-point of an auto-transformer, which is across the two leads from the secondary of the supply transformer.

In operation, at the instant when the terminal T_1 of the power transformer is positive, the flow of current through the circuit will be as indicated by the full arrows. Because of a film of aluminum oxide on the surface of the cathode A_1 it will not permit current

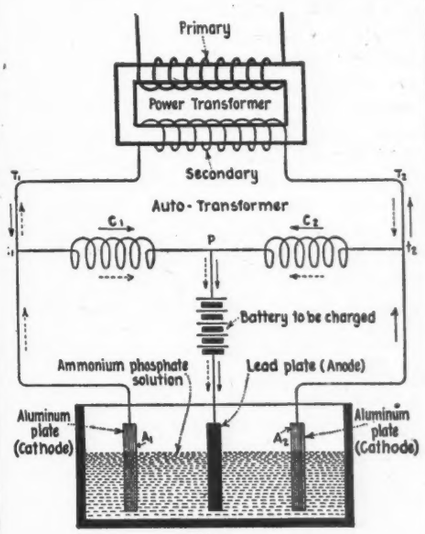

Fig. 2

This shows the principal type of a rectifier, which is the aluminum vale

to pass through the solution in this direction. The current, therefore, flows to the mid-point P, where it is forced toward the battery to be charged. This is due to the fact that the other half C_2 of the auto-transformer, acting as the secondary of a transformer having the coil C_1 as the primary, creates a higher pressure towards P which prevents the current from flowing past the point and through the coil C_2. In addition to this, coil C_2 sets up a current toward P of the same quantity as that in coil C_1 and is added to it. This combined current flows through the battery to the anode, from whence it passes through the electrolyte to the cathode A_2. From the cathode the current flows to the terminal T_2 of the auto-transformer, where the current supplied by C_2 is diverted to the coil to complete the circuit, the main current going back to the terminal T_2.

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With the reversal of the direction of current during the next half-period the path of current through the circuit will be as indicated by the dotted arrows in Fig. 2, the plate A_1 now being the active cathode.

Owing to the heating tendency of the cell, the direct current output of the rectifier is limited to small proportions. This low efficiency, together with the comparatively high cost of operation, has prevented this

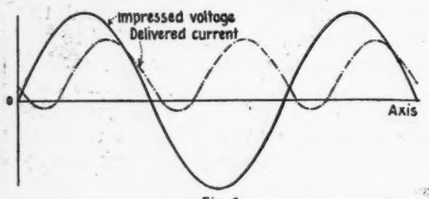

Fig. 3

Typical curves from electrolytic rectifier, showing original supply voltage and the current delivered

type of rectifying apparatus from coming into general use.

The type of rectifier generally used for battery charging in connection with automobiles, annunciators, motorboats, telegraph systems and other apparatus making use of batteries of small capacity is the mercury-vapor arc rectifier. All types of mercury arc rectifiers consist of three essential parts: the rectifier tube; the main reactance and the control panel.

The rectifier tube is a glass bulb from which the air has exhausted and which contains two anodes A_1A_2 usually of graphite and a cathode of mercury C, Fig. 4. Each anode is connected to the separate terminals of the secondary of a transformer from the alternating-current supply, and also through one-half of the main reactance to the negative side of the load, the batteries to be charged. The mercury cathode is connected to the positive side of the load. A small starting mercury electrode S, connected to one side of the alternating-current circuit through a resistance and a switch K, is used for starting the arc in the bulb.

When the tube is rocked, so as to form and break a mercury bridge between the starting anode S and the cathode C, a slight arc is formed, starting the excitation of the tube, and the cathode begins supplying ionized mercury vapor. The latter fills the bulb and comes into contact with the anodes, thereby causing the rectifying action of the bulb to start. The starting switch can then be opened and the tube will continue in operation. The starting current required is small and is regulated by means of the variable resistance inserted in series with the starting anode.

This tube would cease to operate on alternating-current voltage after one-half cycle, if some means were not provided to maintain current flow continuously toward the cathode. This is accomplished through the agency of the main reactance. As the current alternates, first one anode and then the other becomes positive, current passing from the positive anode through the mercury vapor, toward the cathode, thence through the load, and back through one-half of the main reactance to the other side of the alternating-current supply. While the current passes through the reactance, the latter becomes charged, and as the value of the alternating wave decreases, reverses and increases the reactance discharges, thus maintaining the arc until the voltage reaches a value necessary to maintain the current against the counter E. M. F. of the load, and materially reducing the fluctuations of the direct-current supply. In this way, a continuous current is produced with but slight loss in rectification.

In reference to Fig. 4, when the terminal T_1 of the supply transformer is positive the direction of flow of current through the rectifier is as shown in the full arrows. The anode A_1 is then positive, and the arc is free to flow between A_1 and C. Following still further, the current passes through the battery to be charged, thence through one-half of the main reactance coil and back to the negative terminal T_2 of the transformer.

When the impressed voltage falls below a value sufficient to maintain the arc against the counter E. M. F. of the arc load, the reactance R_2, which

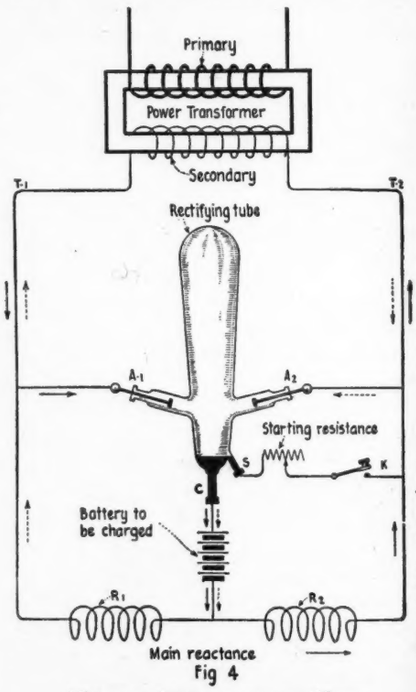

Fig 4

All types of mercury arc rectifiers consist of three parts, the tube, main reactance, and panel

heretofore had been charging, now discharges, the current on discharge being in the same direction as formerly. This maintains the arc until the supply voltage has passed through zero, reversed and built up to such a value as to cause the anode A_2 to have a sufficient positive value to start the arc between it and the cathode C. The discharge circuit of coil R_2 is now through the arc A_2—C instead of

through its former circuit. Consequently, this arc is now supplied with current, partly from the transformer and partly from the reactance coil A_2. The latter circuit from the transformer is indicated in the diagram by the dotted arrows.

The mercury vapor arc rectifier is sometimes used for laboratory work, electrolytic processes and whatever low direct current is required. Low first cost, ease of operation, fairly good efficiency at high voltages and the wide range of voltage and current adjustments are points of advantage of this type of rectifier.

The principal electromagnetic rectifying device is the so-called "vibratory rectifier." The first of two types utilizes but a single wave of each alternating current cycle while the other type works over the complete period. In the single vibrator variety, there is a solenoid acting on a vibrator or spring, connections being made so that when the alternating current wave is in one direction the spring armature is attached to the solenoid, and makes contact such that the current of the higher portion of the wave is used in charging. In the half-cycle, however, the current being reversed, the armature is released, stopping the flow of charging current until the next reversal of the alternating current.

The double vibrator type uses two solenoids with either a separate vibrator for each solenoid or a common vibrator. Connections are such that the solenoids and vibrator-controlled contacts utilize the complete alternating current cycle.

Electromagnetic rectifiers have a low capacity, and therefore, can be easily plugged into the lighting circuit. Their small size and light weight render them readily portable, giving a ready means of battery charging when the only supply current is of the alternating variety.

(*To be continued*)

Safety Method of Fastening Field Wires

OPENING synchronous motor and D. C. motor fields while the machines are running is liable to result in the breaking down of insulation; and in the case of the D. C. machine the motor will run away. Wherever binding posts and connectors, as used for rheostats and fields, are employed, a length of unbroken insulation material should be stripped from the end of the temporary field wire, so that the portion stripped can be passed through the binding post and bent back over the terminals. A complete loop is thus formed, which prevents the circuit being opened, even though the clamping screw in the terminal comes loose. It is not safe to insert in the binding post the bare end of the wire that has been used, since it may be fractured or is liable to be easily broken off.

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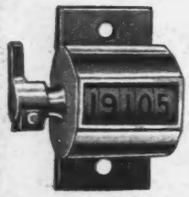

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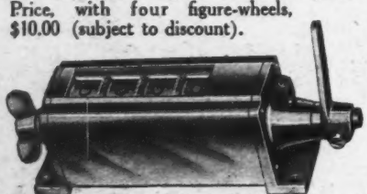

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Inclined and Vertical Drop Shelves for House or Store

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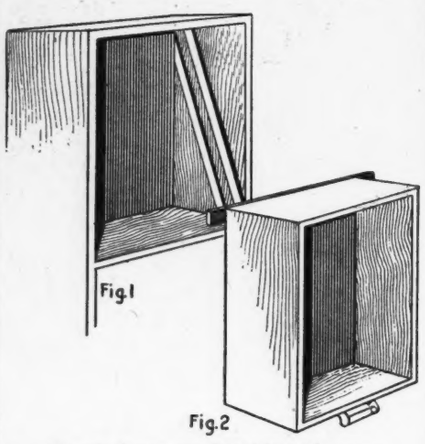


Diagonal grooves fitted into the compartment to receive a slide on the box

Such a shelf in the form of a light frame may be used to display shoes, toys, magazines, etc., in a store or news-stands. This is shown in Fig. 4, and Fig. 5 represents a simplified

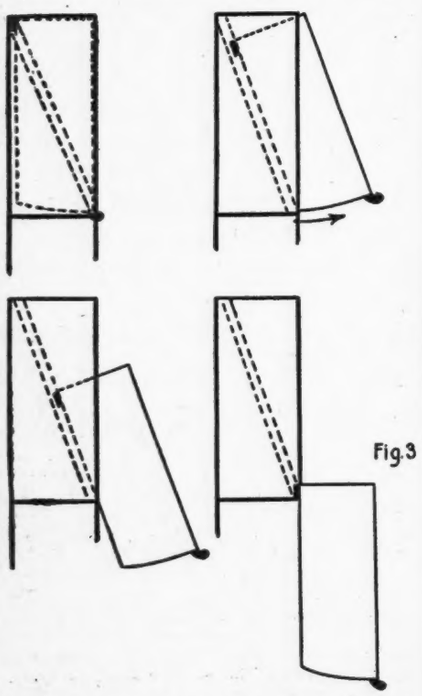
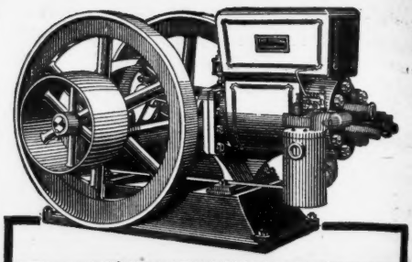


Diagram showing how the box works in the grooves so that it can be lowered



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system of grooves set in an angle, depending on the depth and height of the shelf frame, to take the frame.

In these simple forms the entire

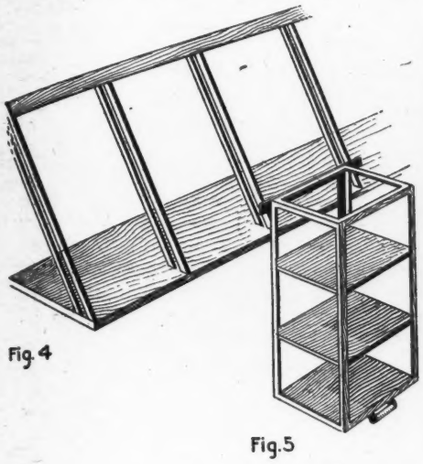

Fig. 4

Fig. 5

Same method used on top of shelving for utilizing space not accessible from the floor

weight of the frame and its contents must be lifted by hand. In a drop shelf of a larger size counterweights must be added. A method of balancing a row of shelf units with but one or two weights is shown in Fig. 6. These weights may be placed in a corner. A vertical drop shelf is shown in

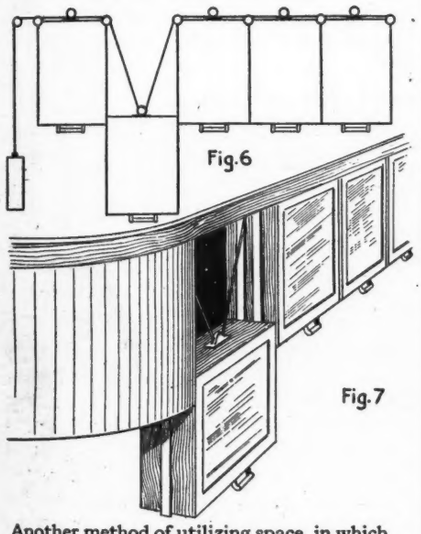

Fig. 6

Fig. 7

Another method of utilizing space, in which the boxes are arranged beneath the ledge

Fig. 7. This is designed particularly for use against a balcony or over a passageway. The guides run in vertical grooves. This type of a shelf should have counterweights.—EDWARD R. SMITH.

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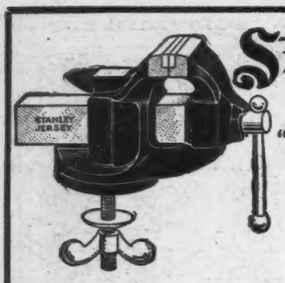

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A New Wireless Chain Between the Americas

By John V. L. Hogan

IT has long been the ambitious dream of wireless men to supplement the present cable systems between the North and South American continents by means of a chain of high-powered radio-telegraph stations. Difficulties in securing concessions and capital,

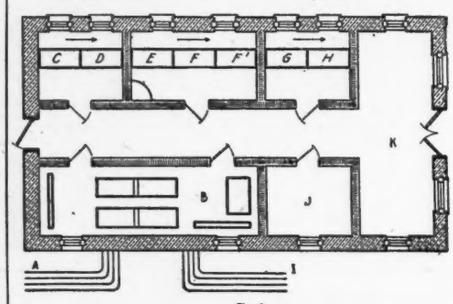


Fig. 1

A typical trans-oceanic wireless operating and receiving station; it contains powerful apparatus

and (by no means least) apparatus capable of working continuously and dependably over great stretches of land and sea, have invariably interfered with the completion of the projected Pan-American systems. At least, if the announcements issued through the press are to be relied upon, some or all of these handicaps have been overcome and the connection of New York and Buenos Aires by wireless will become a fact toward the close of the current year.

A new corporation, called the Pan-American Wireless Telegraph and Telephone Company, has been organized to make use of the Marconi and Poulsen patented systems in a group of powerful plants which will interlink the most important points in the American continents. Concessions which the English Marconi Company and the Federal Holdings Company (which formerly controlled the Poulsen patents in their relation to Pan-American work) had

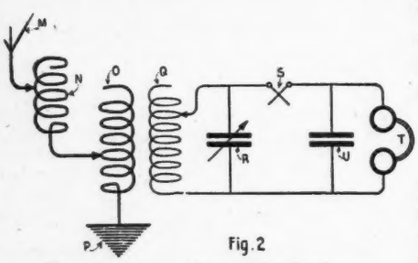


Fig. 2

The wireless receiver of the Poulsen system is the so-called tikker

secured are reported to have been turned over to the new company. It is generally understood that the first work will be to complete the pair of stations for transmitting messages directly between New York and Buenos Aires which were undertaken and announced by the Federal Company some years ago but on which practically nothing other than the preliminary surveys was done. The Pan-American Company has not disclosed its plans for the location of the first station in the United States, but the Federal Company stated that their Northern station would be placed on the coast of Long Island some forty miles from New York. It seems likely that, instead of putting up a new installation, the Pan-American Company will utilize one of the Marconi plants (at New Brunswick, N. J. and Chatham, Mass.) which were erected for trans-Atlantic communication three or four years ago, but which have never been used.

"Damped" and "Undamped" Wireless Systems

The fact that the Poulsen patents are taken over in connection with those of Marconi, implies that the new installations will use the continuous wave system of wireless telegraphy, since the Poulsen arc transmitter produces radiation of the "undamped" or continuous type. There are, broadly speaking, two classes of wireless or radio transmission, viz., the

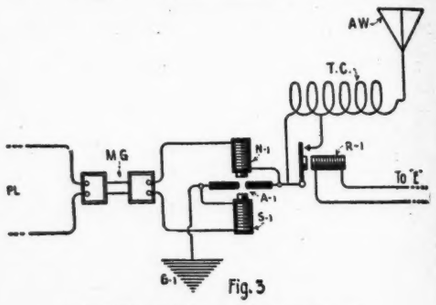
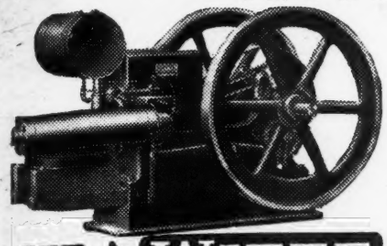


Fig. 3

A typical sender of the Poulsen undamped wave system, the wireless waves coming in on the left lines

"damped wave" and the "continuous wave." The former has been advocated by the Marconi interests for many years, and is characterized by the production of wireless waves in groups separated by intervals of idle time. The continuous wave system, as its name indicates, sends out the wireless waves in an unbroken stream and so uses all of the apparatus all of the time. This system, which the courts have decided was first proposed by Fessenden, has been found by experience to be far more effective than that using damped waves. It is much used by both the enemy and our allied governments in the great war, and forms the basis of the large and successful trans-Atlantic stations at Sayville and Tuckerton in the United States.

The Marconi stations have all been fitted with spark (damped wave) apparatus. However, experiments with instruments for generating continuous waves are stated to have been in progress for some time at the more important points, and the newer generators will doubtless be substituted



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for the spark type (which is now considered obsolete for sending messages over extremely long distances). Thus the new plants for Pan-American service may be expected to radiate waves in a continuous stream instead of in short, separated groups. The increase in effectiveness is much like that found when one puts out a fire by turning a hose upon it instead of attempting to do so by throwing water with a teacup.

A Typical Long-Distance Station

The inauguration of a new service over such extreme distance as the 4,000 miles which separate New York and Buenos Aires, is no small undertaking, and to establish commercial communication before the end of 1918 (which is the schedule announced) will be a remarkable feat. Some idea of the enormous quantity of detail involved may be secured from Fig. 1, which shows the plan of a typical trans-oceanic wireless operating and receiving station. This building is located at some distance from another which contains the powerful sending apparatus, so that the strong electrical disturbances created at the transmitter will not interfere with the receivers. Since the actual Morse operating must be concentrated for effective work, the house shown contains the sending keys as well as the apparatus for reception. This location of the sending control of course, necessitates wire line connections between the operating building shown and that containing the sending plant.

In the diagram, *A* represents telegraph and telephone lines connecting the wireless station with the outside world. Messages for transmission to South America arrive over these lines, and, passing through the switchboard and power room *B*, reach the receiving telegraph operator at desk *C*. Here the operator copies the dispatch upon a blank form and places it upon a traveling endless-belt carrier which runs along the rear of the desks from *C* to *H*, through the dividing walls shown. A second receiving desk is provided at *D*, so that in case of an overload of incoming messages an additional operator may be placed on duty to aid in relieving the congestion.

The written incoming message passes into the radio room in the center, and is automatically lifted off the belt conveyor at the desk *E*, where the sending radio-operator is stationed. Here he works the key which controls the main radio sender by means of automatic switches in the power room *B*, connected over the lines *I* which run to the transmitting apparatus house. Duplicate apparatus and lines must be provided, so that a breakdown will not interrupt the service. On the table behind the sending desk *E* is installed an automatic tape transmitter, which is used to send out long press dispatches and deferred service radiograms. So much for the route of an outgoing wireless message,—the key

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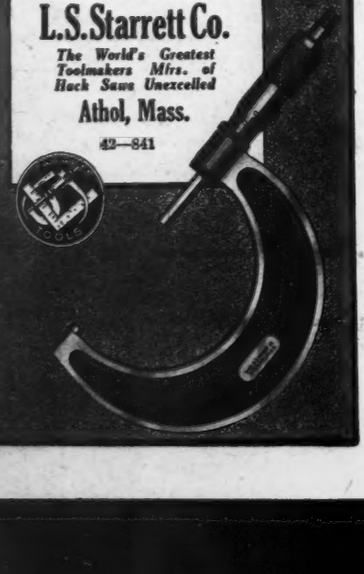
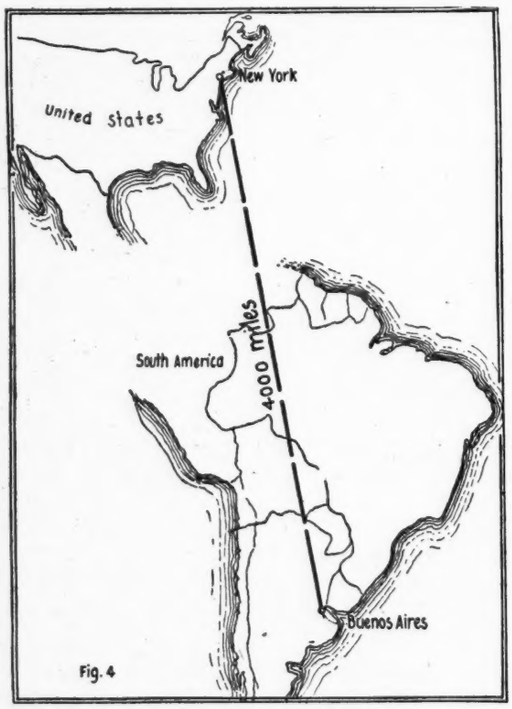


on the desk *E* controls the big sending plant, so that once a word of the written message is formed in Morse characters by the operator there, it is immediately transformed into the dots and dashes of radio waves which speed off into space and reach the South American station a fraction of a second later.

How Incoming Messages Are Handled

Considering the reverse routing, messages which arrive from Buenos Aires as wireless waves strike the aerial wires at the North American station, and are converted into feeble high frequency alternating currents. These currents pass into the radio room by way of the leading-in wire *I* of Fig. 1. The wires *I* are connected to the receiving instruments on desk *F;* and the operator there listens to the dots and dashes, writing out the messages and placing the blanks upon the belt conveyor which takes them into the next room to the right. At *F* is installed a duplicate receiver for use in case of emergency or whenever it is desired to receive simultaneously from two distant radio stations.



Direct line from New York to Buenos Aires, which will link the two American continents by wireless

The desks *G* and *H* in the next room are used for outgoing wire lines, over which the received radio messages are distributed throughout the United States. The room *J* is a small laboratory and shop, for adjustment of instruments and such minor repairs as are often required. The main traffic office is represented by *K* where the clerical work of the station is carried on and where the perforated tapes for the automatic transmitters are prepared upon special keyboard machines resembling typewriters. The power room *B* contains the switchboards for distributing the various telegraph wires to the desks desired, the motor-generators for converting power to the voltages needed for telegraph work, the relays, magnetic switches and other larger apparatus whose operation might disturb the telegraphers. The reason for locating the sending and receiving desks together in the radio room is that thus the receiving operator may at any moment interrupt the sending of outgoing radio messages to secure a repetition or confirmation of any obscure letters or words in an incoming dispatch. It is apparent that, with a station arrangement of this character, messages are simultaneously in transit in both directions,—in other words, the wireless is "duplexed."

Duplex or double operation is much facilitated by the use of continuous waves, and only moderate separation of the sending and operating houses is required. With some special devices they may be only a few hundred yards apart, or even in the same large building.

The Receiver of the Poulsen System

The wireless receiver of the Poulsen system is the so-called "tikker," which is shown at *S* in Fig. 2. This diagram shows how the aerial wires *M* are connected through the tuning coils *N* and *O* to the ground at *P*. It is through these wires and coils that the high frequency currents flow. A secondary coil *Q* and tuning condenser *R* are associated with the antenna circuit coils, and from the condenser wires lead to the "tikker" *S*, a telephone *T* and a telephone condenser *U*. The "tikker" is merely a rapid interrupter of any one of several forms, which serves to make the wireless signals audible to the operator who listens in the telephone receiver *T*. This "tikker" receiver was first put out some ten years ago, and has had extensive use. It is now largely supplanted by other more effective devices, one of which will doubtless be used in the Pan-American stations.

The Poulsen Arc Sender

A typical sender of the Poulsen undamped wave system is shown in Fig. 3, where the electrical power comes in over the power lines *PL* and goes to the motor generator *MG*, which produces the high voltage direct current needed. This current passes through the windings of two powerful electro-magnets, *N'* and *S'*, to the arc *A'*, which is the most important element of the system. The arc has one electrode of copper and the other of carbon, and burns between the two magnet poles in an atmosphere of hydrogen gas. The carbon electrode is normally connected to ground *G'*, and the copper to the aerial wires *AW*

through a tuning coil *TA*. The unusual property of such an assembly is that the arc, when properly adjusted, converts the applied direct current into radio frequency alternating current suitable for wireless transmission. The waves of the frequency desired for sending are turned off and on by the magnetic switch or relay *R'*, which is controlled from the desk *E* (Fig. 1) over the wire lines *I*.

Although the details may be altered a great deal without changing the general plan, the modern long distance wireless station is well typified by the above illustrative installation. The new Pan-American Company has not announced the exact arrangements which it proposes to use, but in principle they are not likely to depart very far from those just outlined. The radio profession, as well as the business world, is interested in watching this newest great wireless project; and only good wishes and encouragement are to be extended toward the men who now attempt to interlink more closely the two American continents.

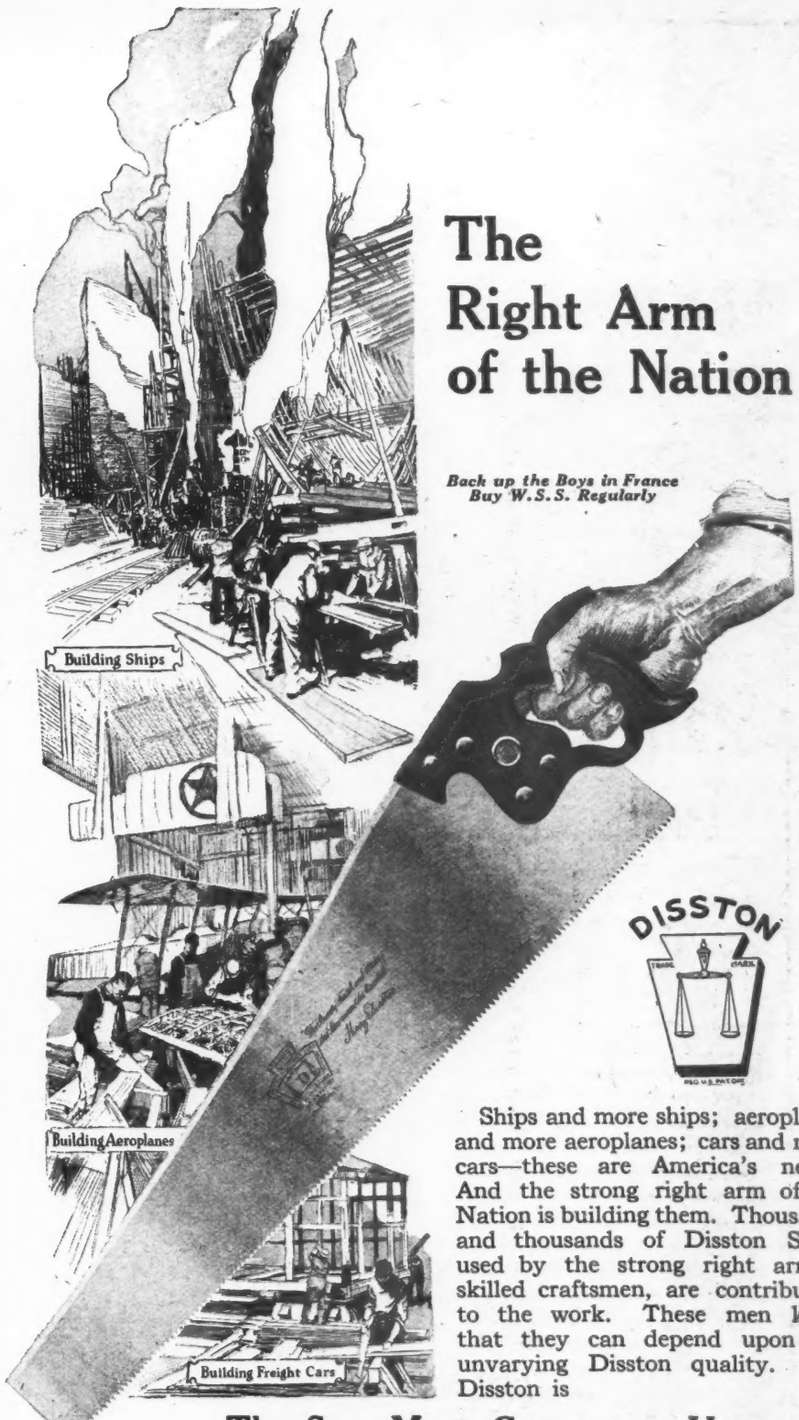
A Ring and Chain Prevents the Theft of the Pressure Gage

A GASOLINE service station attendant is responsible for the following kink. He lost several tire gages through motorists absent-mindedly slipping them into their pockets and forgetting to return them. After losing three in one week he enlisted the aid of a machinist. A ring was made of ¼-in. iron, 1 ft. in diameter, to which was attached a chain of light construction. At the end of the chain and well soldered to it hangs the gage. This attendant now invites the motorist to put it in his pocket. Aside from a theft precaution it is convenient, as the gage has its regular nail, and when not in use hangs therefrom.—VIRGIL R. THARP.

The large ring cannot be put in the pocket

Enlarging a Hole in a Small Pulley Without a Reamer

IN doing some model work, a mechanic found himself without a hand reamer of the proper size to enlarge a hole in a small pulley. Looking about him for a substitute, he took a small round file less than ¼ in. in diameter and ran it through the hole. For the propelling power to revolve the pulley on the file, he used a driving belt from a sewing-machine wheel. Turning the driving wheel around and holding the ends of the file, the hole was enlarged quickly to the proper size.



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Wish to say that the Freeze-Proof is satisfactory in every respect. We have recently had temperature of 20 below zero and it did not freeze in my car at that time.—W. J. DYSART, Woods-Everitz Stove Co., Springfield, Mo.

We used several cases of your Freeze-Proof last winter and the very best of results were obtained from its use. It was satisfactory enough that we are stocking in again this season.—CITY GARAGE OF TYLER, Tyler, Texas.

We have used your Freeze-Proof for the past year and it gave entire satisfaction, and placed our order for the coming season.—MADISON MOTOR CO., Madison, Maine.

I put your Freeze-Proof in my radiator and have had satisfactory results. I had it in the radiator while the thermometer registered 22 below zero. No injury was done. I shall be your patron henceforth.—REV. F. ADIX, Rush Center, Kans.

Our confidence in Freeze-Proof is such that we have just placed an order for an additional carload for the coming season, and quite naturally we could not have the nerve to handle this quantity if we did not have most profound confidence in the product.—THE SALT LAKE HDWE. CO., Salt Lake City, Utah.

In regard to your Freeze-Proof, beg to say that when it has been used according to directions I have had the very best success. When the proper amount is used even in the most severe weather I have not had a single complaint of cars freezing. —W. S. DOUGHTY GARAGE, Parker, S.D.

I am glad to say that among the many things I have tried I found your Freeze-Proof solution the only one that did the work. The temperature here is now 10 below zero, and my radiator did not freeze. I advised all my friends to buy Freeze-Proof and avoid trouble in cranking their automobiles.—ALFRED HILL, Danville, Ill.

Have used your Freeze-Proof and find it all that you advise it. Will probably always use it unless I find something better, which I doubt I ever will.—H. H. PECK, New Milford, Conn.

I have used Johnson's Freeze-Proof during the winter 1917-1918 and can recommend it to all car owners. It was tested in my car to 20 below zero. For that reason I dare to recommend it. —REV. H. NIELSON, Poysippi, Wis.

I have used Johnson's Freeze-Proof in my Ford car all of this unusual cold winter with complete satisfactory results.—DR. WM. F. HAKE, Grand Rapids, Mich.

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Don't wait until the freezing weather comes to think about protecting your car for the coming winter. Decide early to use Johnson's Freeze-Proof—purchase your **supply** from your dealer and read the directions carefully. A little time spent now in cleaning the radiator and putting on new hose connections will save you unlimited time, trouble, worry and expense during the winter months.

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is the logical anti-freeze preparation to use. It is inexpensive—does not evaporate—is non-inflammable—is easy to use—and is guaranteed. One application will last all winter unless the solution is lost through the overflow pipe or leakage.

One package will protect a Ford to 5° below zero, one and a half packages will protect a Ford to 30° below zero and two packages will protect a Ford to 50° below zero. For larger cars, or to protect to a lower temperature, use additional Freeze-proof according to the scale on the package.

I have used Johnson's Freeze-Proof in my Overland car all winter and have had absolutely no trouble. After going through this winter, which has been the hardest winter in my memory, without any sign of trouble, I have no hesitancy in recommending Johnson's Freeze-Proof.—J. VAN NORMAN, Asst. Business Manager, The Herald, Grand Rapids, Mich.

I used your Freeze-Proof this past winter, and as you will recall, it was the worst weather we have had in many years. It protected my seven-passenger car to as far as 20 degrees below zero and did not show the least particles of crystals in the radiator. Johnson's Freeze-Proof is the best insurance one can have on the cooling system of any car.—C. W. MALLORY, Georgetown, Ky.

My automobile radiator and engine holds twelve gallons of water. Early this winter I put in three packages of your Johnson's Freeze-Proof. It has been five degrees below zero and we have had the coldest winter we have ever had in Virginia. My car has been kept in an unheated garage and your Freeze-Proof has done all that you guarantee it to do as we have never had it freeze or the water thicken.—HORACE L. SMITH & CO., Inc., Farm Machinery, Petersburg, Va.

We wish to say at this writing, we want to compliment your company for the wonderful co-operation that we have had towards the sale of Freeze-Proof this past season. We haven't a package of Freeze-Proof left in stock and sold same to owners of cars where the prices of these cars carried from $1,000.00 to $15,000.00 and not in one instance did we have a complaint for this product.—JOHN J. MAHONEY, Treas. Motor Accessories, Inc., Boston, Mass.

We have used Johnson's Freeze-Proof this winter in Peerless Eight, Chandler Six, Ford, Wilson and Republic trucks. This has been the coldest winter we have had for years, zero and lower right along. But notwithstanding the extremely cold weather all of the above cars and trucks have worked every day and not one of them froze up. We consider your preparation the best we have ever used.—JOHN T. BYERS, Supt. Labor Brewing Co., Uniontown, Pa.

Recently I left the car in my unheated garage and went out of the city. The car stood for a week in the cold garage, during which time we had the coldest weather of the season, the thermometer being 36 degrees below zero. When I returned to Calgary to my surprise I found the car in perfect shape. I figure that the two boxes of Johnson's Freeze-Proof which I used saved me possibly $100.00.—A. J. McMILLAN, Mgr. Robin-Hood Mills Co., Calgary, Alta., Can.

I have used Johnson's Freeze-Proof in my Overland six which is a regular type Continental motor. Although this was a very severe winter, Johnson's Freeze-Proof stood the test.—H. E. GNADT, General Hardware, Chicago, Ill.

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